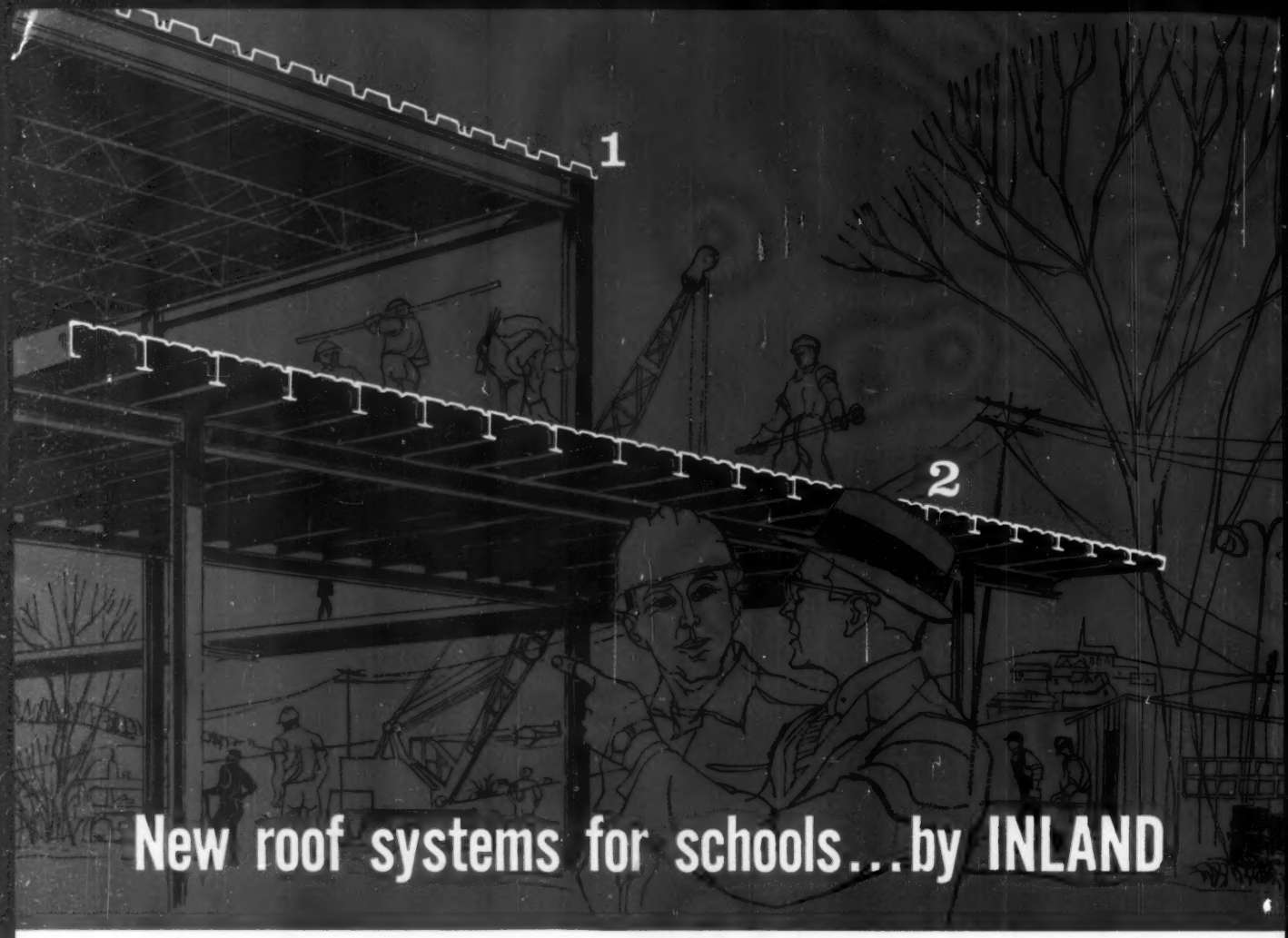
# Consulting Engineer

December 1961

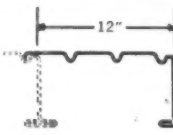
Photo by Fabian Bachrach

PIER LUIGI NERVI, joint owner and director of Ingg. Nervi and Bartoli, Anonima per Costruzioni, Rome, has won some of the world's top awards in architecture. Yet Professor Nervi, whose firm does architecture, engineering, and construction, dislikes the neat separation between architect and engineer which is currently in vogue. In fact, he believes that some of history's most beautiful buildings are simply ingenious solutions to fundamental structural engineering problems.

*Continued on page 10*




# New roof systems for schools...by INLAND

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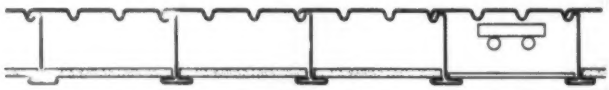
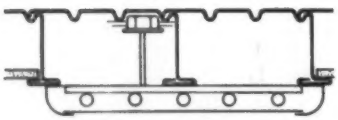
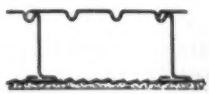
**Ceiling Treatments with T-Steel Deck**



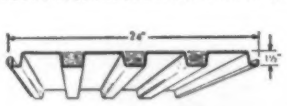
Standard Tile or Board — Light Diffuser



Surface-Mounted Fixture



Lath-and-Plaster Fireproofing

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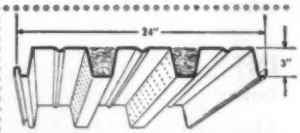


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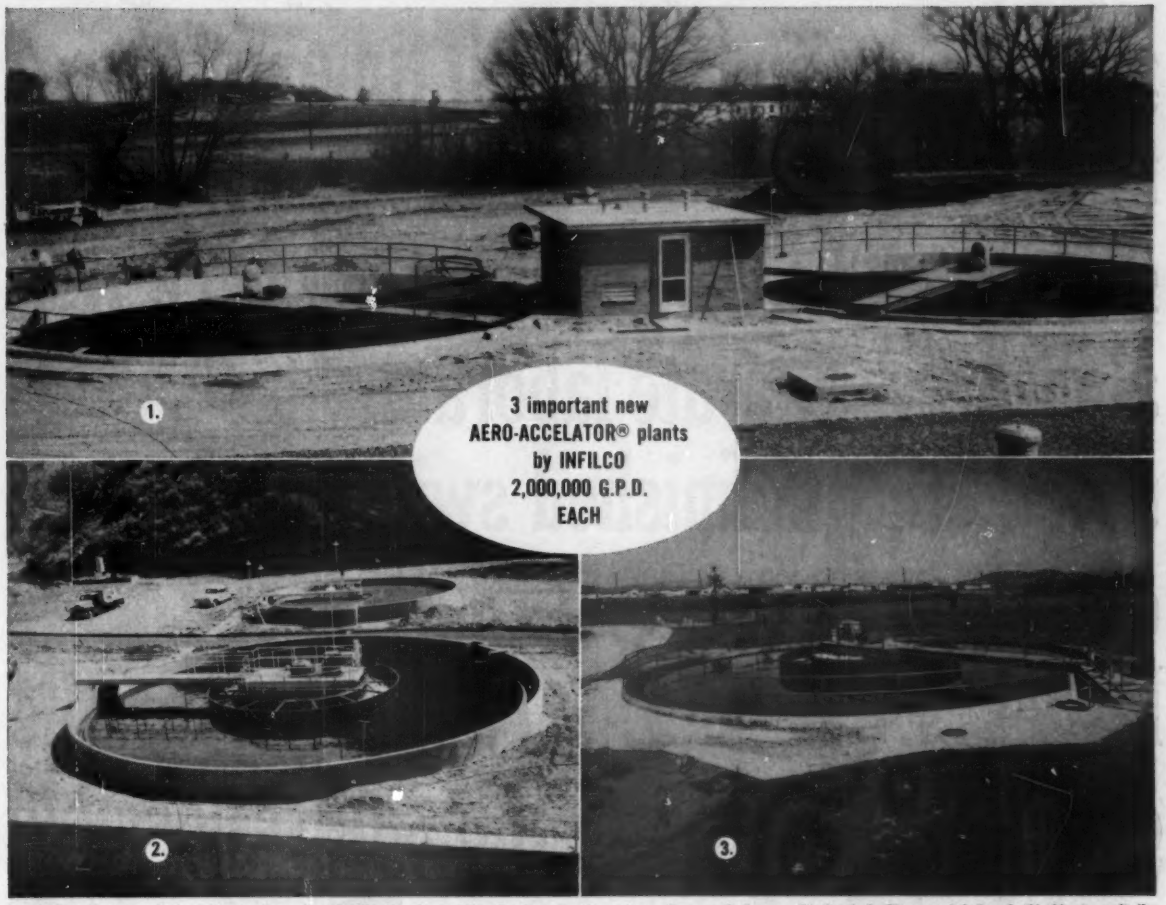


1. Litchfield, Minn. Twin unit plant, each unit 47′ dia. Consulting Engineers—Bonestroo, Rosene & Assoc., St. Paul. 2. Thousand Oaks, Calif. Single unit (in foreground), 67′ dia. Consulting Engineers—Pomeroy and Associates, Pasadena. 3. Santee, Calif. Single unit, 67′ dia. Consulting Engineers—Lawrence, Fegg, Florer & Smith, La Mesa, Calif.

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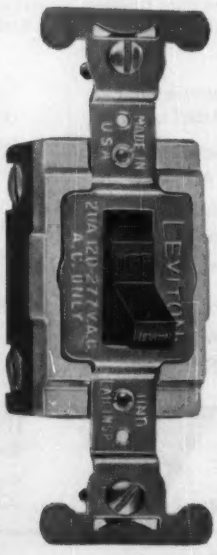


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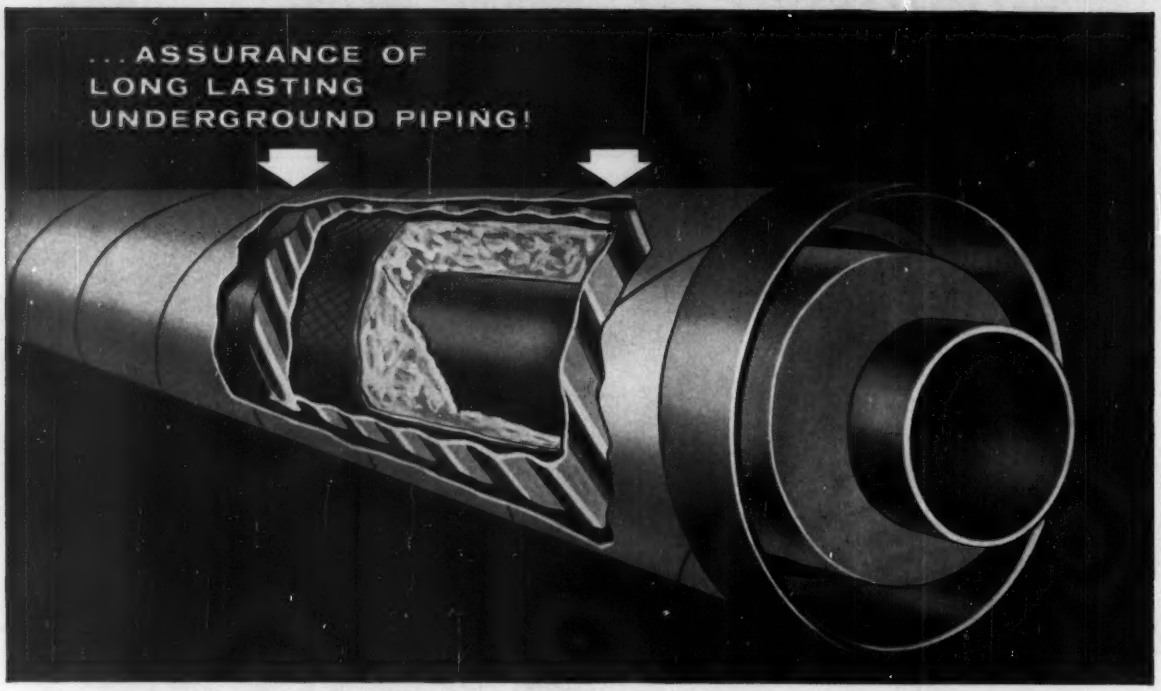


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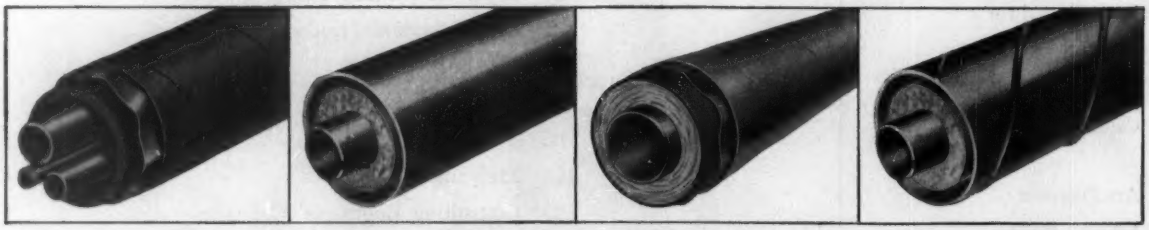

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4. two direct-to-drum assemblies, one on each end of the drum.
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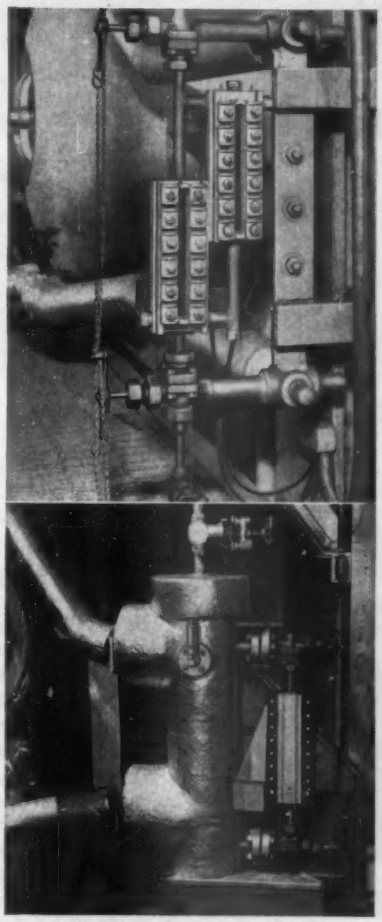

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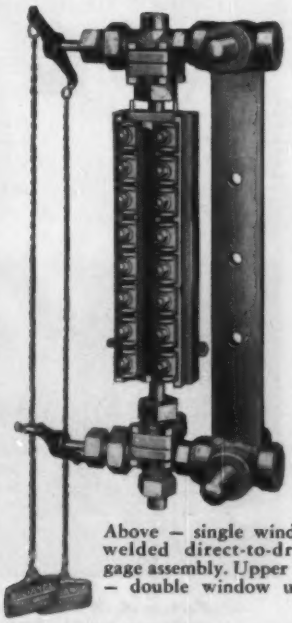

Above — single window welded direct-to-drum gage assembly. Upper left — double window unit.

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# How Imaginative Engineering Provided Air Conditioning To Fit A School Budget

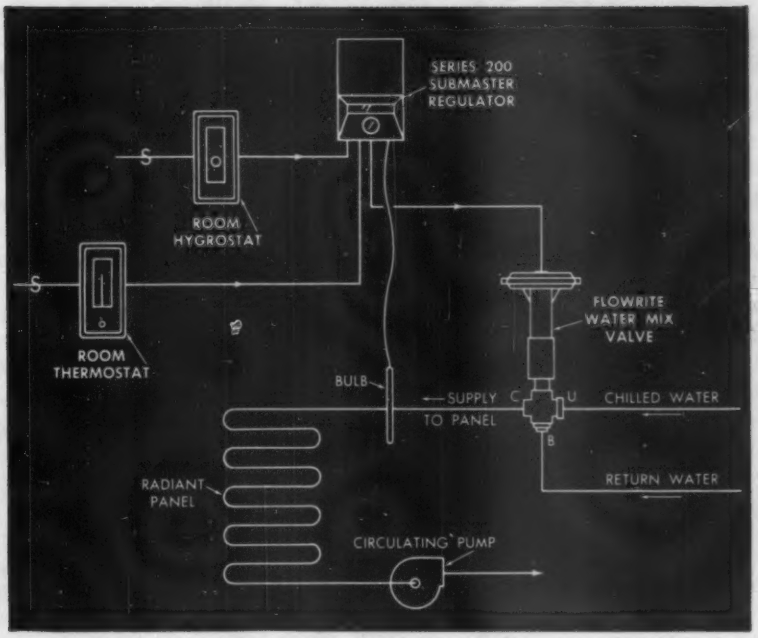
**Must school air conditioning always be "too expensive"? Perkins & Will, Chicago architects and engineers, didn't think so last year when they designed suburban Homewood-Flossmoor High School. Without exceeding the school budget, they provided an air conditioned area large enough for complete summer sessions, including 15 classrooms, the library and all administrative offices. Actually, cooling for 25,000 square feet added less than 3½% to normal building cost — less than $4 per square foot of cooled area.**

*Homewood-Flossmoor High School,* Flossmoor, Illinois. Air conditioned section (center) connects to other school facilities by glass-enclosed passageways.
*Architects and Engineers:* PERKINS & WILL, CHICAGO
*Mechanical Contractor:* THE ECONOMY PLUMBING AND HEATING CO. OF CHICAGO.

*Perkins & Will team of architects and engineers works out details of the cooling system design features and controls for the Homewood-Flossmoor school. From left to right are F. Philip Brotherton, Designer and Project Architect; Rudolph J. Houkal, Chief Mechanical Engineer, and Edward C. Colin, Chief Structural Engineer.*

## How it was done

**Perkins & Will grouped all rooms where both heating and cooling were desired into one section of the school. An interesting design feature is the core of 15 classrooms, surrounded on all sides by other rooms. The fuel savings realized from this "insulated" core help defray the added expense of cooling the entire summer school section. The engineers concentrated all mechanical service equipment beneath this section to eliminate long air conditioning channels. Double ducts and automatic controls were carefully designed for easy switchover to cooling and to take full advantage of tempered return air and outside air during spring and fall seasons.**




## Ceiling Panel Condensation Control

To back up the mechanical efficiency it so carefully designed into the heating, cooling and ventilating system, the Perkins & Will firm specified a Powers system of pneumatic temperature control, including the important dew point control which acts on the chilled water auxiliary cooling used in rooms exposed to the outside. This control (see diagram) utilizes a Powers Water Mix Valve on the ceiling panel chilled water supply and a low limit Submaster Regulator. The Powers Hygrostat measures room humidity conditions and resets the low limit temperature to prevent condensation on panel surfaces, yet allows supply water temperature to be as low as possible for maximum cooling.

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*Homewood-Flossmoor Maintenance Superintendent William C. Drews (left), takes readings from the automatic Powers pneumatic control panel.*

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## PIER LUIGI NERVI

– *Starts on front cover*

Although he was presented the Gold Medal of Architecture by Queen Elizabeth last year, Nervi is academically classified as a civil engineer. He teaches engineering and has written many technical articles and books, but spends little time reading – particularly, he avoids reading the material that tends to theorize architectural criticism. He dislikes talking about himself, yet is interviewed quite often, because he is too polite to say "no" to anyone.

"I have never thought of myself as an architect," he said. "By education and by choice, I am an engineer. However, I see no separation between an architect and an engineer. We have a common area of responsibility; we both strive for the same results – that is: a structure with strength, utility, and grace, constructed in sincere collaboration from concept to final realization." He decries the separation between architecture and engineering in universities.

### An Unwilling Artist?

Called "an artist against his will," Nervi is famous for his concrete structures – mostly public buildings. According to the *New Yorker* magazine description of his works, "Nowhere in his work does concrete seem unwieldy or massive, and nowhere is a concrete beam or arch an iota heavier than it needs to be in order to carry the stress imposed on it. The answer lies in Nervi's intimate knowledge of concrete and its capabilities; he can spin the stuff as easily as a Venetian craftsman spins glass."

Although Freyssinet's trend-setting parabolic hangars were built at Orly in 1916, followed by the Bagneux locomotive sheds in 1929, Nervi claims that it was not until the late '30s that he became fully aware of the experiments of Perret, Maillart, Freyssinet, and others, and that his own personal expression developed partly through this cultural isolation, which he considers a peculiarly advantageous, if not particularly praise-worthy, circumstance. "The thought never passed through my mind to question how others had, or might have, solved similar problems," he added.

Nervi calls concrete "the finest construction material man so far has been able to find. Concrete will do anything. Apart from its other advantages, concrete has the virtue of economy." He also has developed his own form of concrete – Ferro-Cemento, a smooth concrete mix of cement mortar reinforced by several layers of fine steel mesh and bars of small diameter. He developed his system of construction by using special molds to gain the advantages of prefabrication, and to produce surfaces that need no finishing.

His interest in concrete can be traced to one of his other obsessions – economy. In Italy, steel has been in short supply many times and also is comparatively expensive. Nervi considers economy the ultimate achievement in his designs.

"In my long life as a designer and builder, I have seldom found clients capable of stating their problem clearly, of choosing the designer and his design wisely, or of accepting the responsibility for a daring structural or aesthetic solution. Even if both clients and designers were lacking in taste, they would achieve better results, perhaps unknowingly, by following sound economic criteria." However, he does have respect for his clients' judgment. "The average quality of the architecture of a nation is more influenced by the tendencies and the cultural level of the clients than by the knowledge and aesthetic sensibility of its architects . . . In a coarse society, the refined architect will be permanently unemployed."

### A High Regard for Concrete

Nervi's respect for reinforced concrete (he does not use prestressing much, for his designs do not often lend themselves to the technique) extends beyond the desire for economy. In his *Structures*, Nervi states:

"Because of its high compressive strength, its exceptional weather resistance, its constructional simplicity, and its relatively low cost, reinforced concrete is truly the most interesting and promising structural material available to mankind today.

"The quality of the concrete does not depend only on the quality of the cement, which usually monop-


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"Whenever I have witnessed the lowering of the forms of a large structure constituting a single static system, I have noticed the impossibility of lowering all the forms simultaneously, and asked myself with deep anxiety whether the strains and the irregular conditions of loading to which the structure was subjected at the time would not induce stresses far above allowable limits, or even above the ultimate strength of the structure. The adaptability of concrete structures to unforeseen conditions and their capacity to overcome temporary critical strains always fill me with wonder and admiration."

### Nervi's Early History

The son of a postmaster, Nervi was born in 1891, in Sondrio, a small Alpine village in northern Italy. Because of his father's job, Nervi lived in a number of Italian towns before attending the University of Bologna. Although he had been fascinated by all things mechanical when he was a boy, Nervi decided structural engineering would be his career.

In 1923, after serving as a lieutenant in the Italian Army Engineering Corps during World War I, Nervi formed a partnership with Nebbiosi, a contractor. One of the first all-concrete buildings designed by Nervi was the Cinema Augusteo in Naples, which brought considerable criticism from contractors and architects, who insisted the structure would collapse from lack of proper support. The building is still standing, despite several near-misses by Allied and Nazi bombs.

Nervi called the Municipal Stadium in Florence his first "important project." On this project, the curved stairways to the grandstand are outside focal points of the stadium, and follow the line of a semihelix. They are 10-ft wide and cantilever out from an inner spiral beam. To reduce the considerable torsion moments, the inner beam is supported by a counterspiral beam. This system cannot be structurally analyzed exactly, so assumptions were made to simplify calculations. These staircases are still in perfect condition.

In 1932, Nervi formed a new company in partnership with a cousin, Ing. Giovanni Bartoli. Although Bartoli died in 1957, the firm has continued under the same name. Today, three of Nervi's four sons are active in his firm. Two are architects, Antonio and Vittorio, and one a civil engineer, Mario. (The fourth, Carlo, is a physician specializing in cancer research).

In 1940, the Italian government assigned Nervi the job he considers his most important work from a structural point of view — the design of eight hangars, each approximately 330-ft long by 130-ft wide.

On this project, Nervi used his own special technique of prefabricating the basic elements for the first

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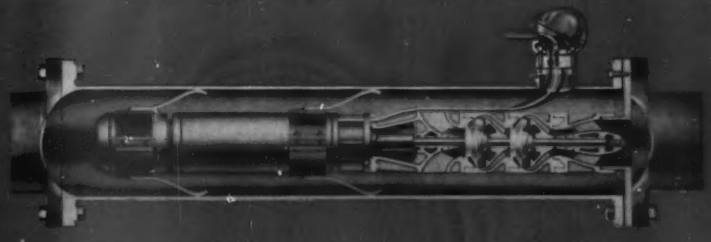
The Layne In-Line Submersible pump provides the answer to many problems in booster pump applications. The pump operates as an integral part of the line and is designed for use by municipalities, industry, such as petroleum and chemical plants and by agriculture. Advantages include: simple installation, no additional space required, continuous service even under flood conditions, and no possibility of surface water contamination.

Layne In-Line pumps are made as small as 4 inch bowls on a 4 inch motor for use in a 6 inch pipe to deliver 30 GPM. Larger sizes are available as required. For additional information write for free bulletin number 203.



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Magnetrols are available for controlling *liquid level* changes from ¼" to as much as 150' and more — with single or multi-stage switching; *flow switches* to signal start, stop or insufficient flow within fractions of gpm rates.

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time. Concrete spans were reinforced with steel rods. The spans were hoisted into place, the rods were welded, and the joints were covered with more concrete. When the Germans were retreating during World War II, the hangars were dynamited, with the charges set off at the feet of the columns. Nervi, wandering around the site later, found all the joints in the rubble — undamaged by time or dynamite.

Perhaps one basis for Nervi's theories on economy is this project. Because of wartime shortages, Italy had little steel available, and Nervi's assignment was to design using an absolute minimum of steel.

### On War and Frank Lloyd Wright

In all his interviews, Nervi has avoided two subjects — World War II and Frank Lloyd Wright. Whether he considers both to be calamities is not known. Nervi refers to World War II as "a sad and terrible experience." He has mentioned that he lost all his equipment and most of his other assets, and had to refound his business at the end of the war.

As to Frank Lloyd Wright, Nervi insists that "I am not familiar with his work," and cannot even be pressed to comment on that last outpost of the Maginot Line, the Guggenheim Museum in New York City.

### Important Nervi Designs

During the past 15 years, Nervi has designed many famous buildings. His fame (he says) dates from the Turin Exhibition Hall, the first time Ferro-Cemento was used as a basic material for a large vault. He recently completed another project in Turin, the Palazzo del Lavoro, a huge exhibition hall. The building, 525-ft square and 82-ft high, has tapered steel girders cantilevered radially from concrete columns.

Visitors to the Olympics in Rome saw a number of Nervi projects, but his favorite is the Palazzo dello Sport, situated on a hillside where Mussolini had planned an international exposition for 1942. The dome of this $3 million arena is nearly three times the diameter of the 138-ft dome of St. Peter's Basilica; at its highest point it is 106 feet above the floor.

In Paris, Nervi worked with Marcel Breuer and Bernard Zehrfuss to design the UNESCO headquarters auditorium. Breuer is one architect about whose work Nervi speaks enthusiastically.

Nervi now is working in North America for the first time, and he has three projects in various stages of construction. The first, about which relatively little information has been released, is the Dartmouth College auditorium.

In New York City, Nervi has designed the scalloped roof of the New York Port Authority bus terminal. The roof design includes 26 triangular sections, 14 of which slope upward from a row of columns in the center of the building. Vertical sides of the raised roof sections will be glass enclosed and louvered for ventila-

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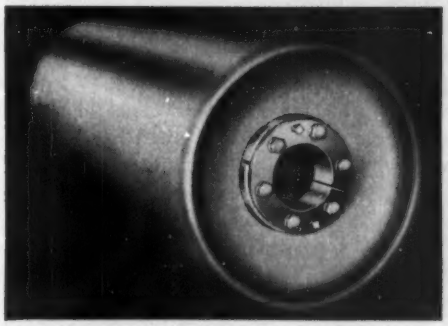

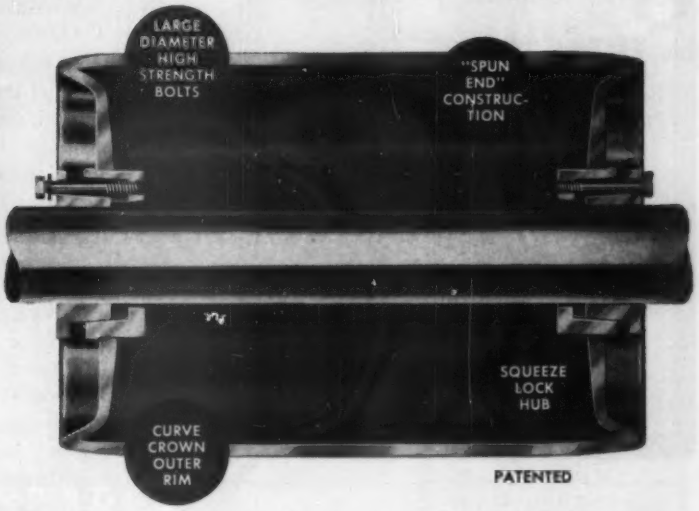


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### "SPUN END" CONSTRUCTION

Exclusive, one-piece, all steel "Spun End" construction eliminates weldments in areas of high stress concentration, a major source of fatigue, warping and trouble. "Spun End" construction allows the placement of maximum metal thickness at end plate bore reducing unit pressures of radial loads while providing thin plate flexibility to accommodate shaft deflections.

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Revolutionary SQUEEZE LOCK Hub design effectively transfers loads from rim to hub and from hub to shaft. Hub design provides gripping power for full torque transmission without the use of keyways and eliminates distorting loads against pulley "Spun End." The SQUEEZE LOCK Hub accomplishes this by exerting equal locking forces in two directions — to both shaft and pulley end plates — through a self contained hub. The outer bushing expands against pulley end plate, while the inner bushing contracts against shaft by tightening six large diameter, high strength bolts.

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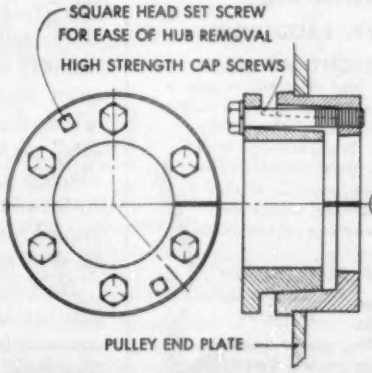
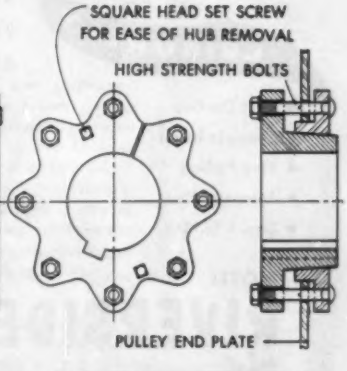



SQUEEZE LOCK Hub furnished with STANDARD CURVE CROWN "SPUN END." Pulleys from 1" thru 4½" bore.

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WRITE FOR BULLETIN 1160

S-A

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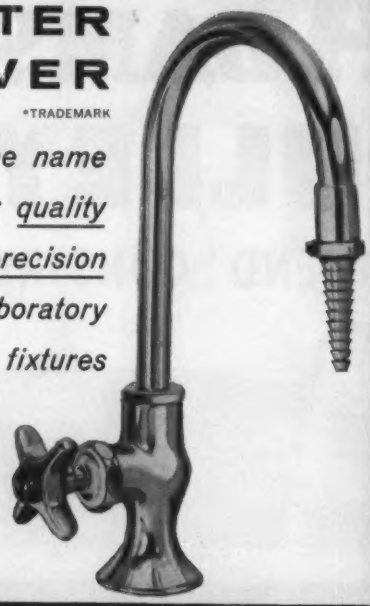

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tion of bus loading platforms. The $13 million terminal will cover two blocks and will handle an estimated 50,000 passengers daily when completed.

Montreal will be the site of a 51-story, three-tower office building designed by Nervi and Luigi Moretti. One tower, and the surrounding rotundas, are scheduled for completion in 1963. Total project costs are estimated at $50 million.

Each of the three towers is to be surrounded by petal-shaped rotundas, three stories high and extending out 18 feet over the street. The office building will have seven underground levels for parking, stores, and recreational facilities.

Nervi, whose more unusual projects have been a combination of engineering intuition and structural model testing, also has arranged to work with Lockwood, Kessler & Bartlett, Long Island consulting engineers, on future projects in the United States. The U. S. firm will make the model tests, and also will use computers for compiling stress distribution figures.

### Italian Construction Customs

Although Nervi is versatile enough to adapt to engineering customs in any country, he thinks there are many advantages to Italy's system of awarding public projects on a bid basis. Nervi, because of his combination of architecture, engineering, and contracting under one roof – combined with his continuing research in uses of concrete and in unusual construction methods – is difficult to underbid.

He also likes the system of combining design and construction in one firm. "The system of doing both design and construction stimulates progressive design. A firm doing both well will arrive at the most economical solution, yet also retain beauty and client satisfaction. It results in a closer contact with the job. The combination will work, of course, assuming the contractor is an engineer."

Nervi lives and works in the same building, on a quiet street overlooking the Tiber River. He goes across the hall to his office early, takes a long "siesta" period at lunch, then stays at the office until about 8 o'clock at night. Although he has a staff of 15 to 20 young engineers and architects (who seem to regard him more as a professor than as an employer), he does most of his design alone in a small office.

He takes a strong interest in the education of future architects and engineers, and prefers the American system of giving a general education with a bachelors degree, then leaving specialization to graduate students. He thinks the Italian engineering courses are too specialized for the average student, and not specialized enough for the exceptional youth. Combining practical experience with classroom knowledge also is a necessity. "Learning engineering from a textbook is like learning to sail a ship on dry land," he commented. ▲▲

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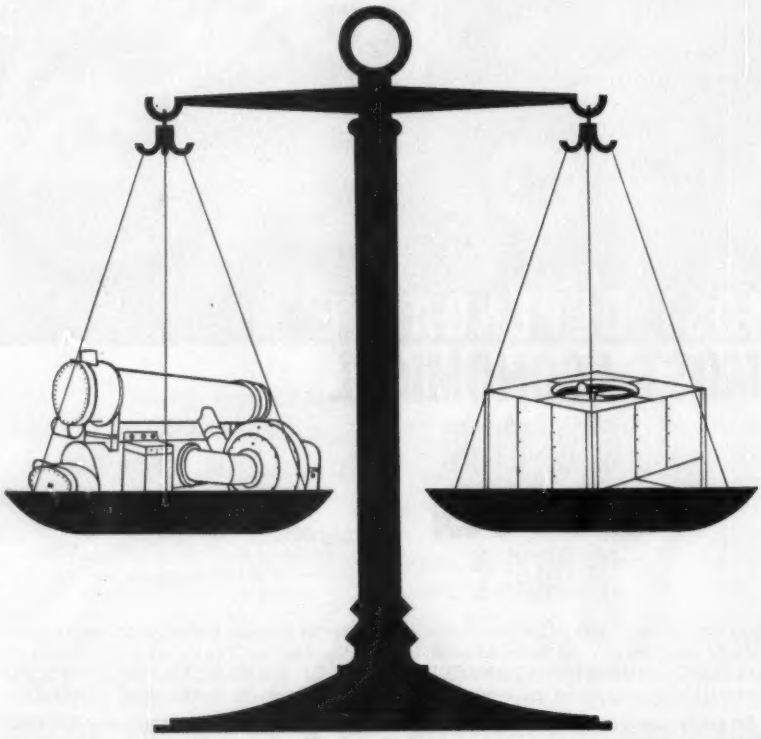
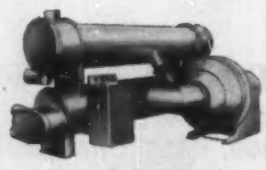
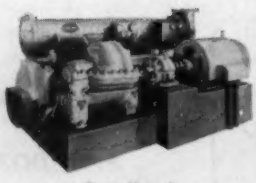


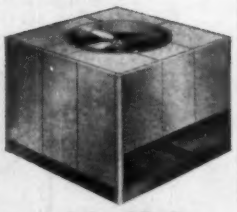
**Automatic Absorption Refrigeration Machines**
Capacities: 50 to 1000 tons



**Hermetic Centrifugal Liquid Chilling Packages**
Capacities: 100 to 2000 tons



**Centrifugal Refrigeration Machines**
Capacities: 100 to 5000 tons



**Induced Draft Cooling Towers**
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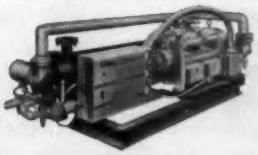
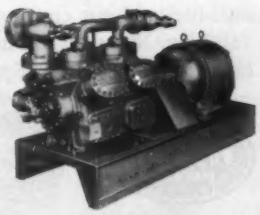
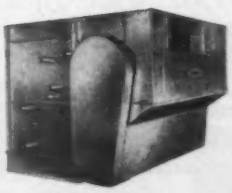


**Liquid Chilling Packages**
Capacities: 15 to 125 tons

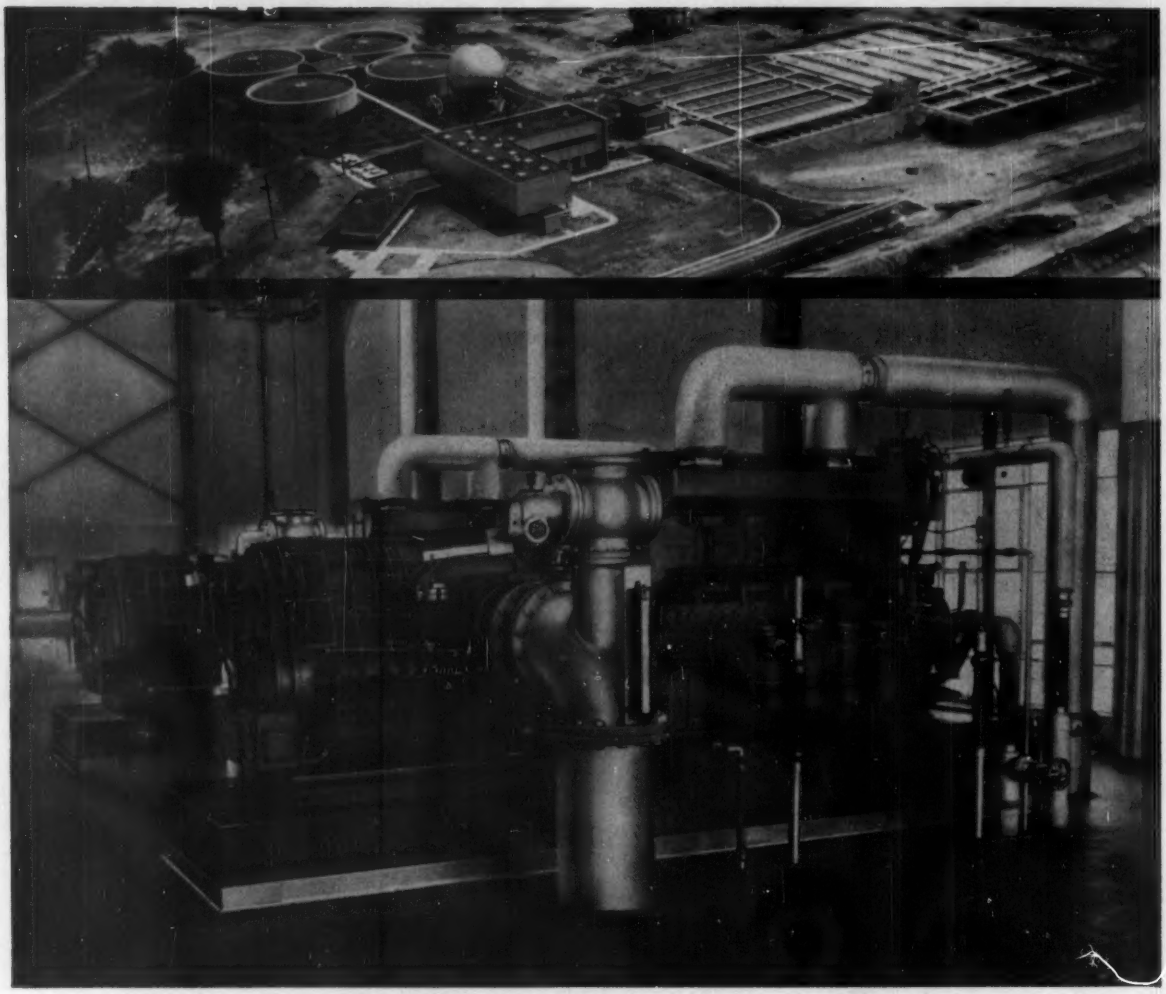


**Reciprocating Compressors**
Capacities: 5 to 250 tons



**Evaporative Condensers**
Capacities: 10 to 250 tons

**Air-cooled Condensers**
Capacities: 5 tons and up



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# The Word From Washington

EDGAR A. POE,
Consulting Engineer
Correspondent

### CE's Get Into Civilian Defense Act

Many consulting engineers across the nation will be called upon to supply technical services for the new fallout shelter program provided by Congress. A total of $207.6 million was authorized, with $169.3 million, or 83 percent, earmarked for shelter survey and marking of existing structures, making improvements, and establishing shelters in new and existing Federal buildings. Additional sums are earmarked for food (dry survival rations, five-year shelf life), water, tools, sanitation, medical and first aid supplies, and research and development.

Congress also provided $73.2 million for the Department of Agriculture and the Department of Health Education and Welfare to relocate government-owned wheat supplies and obtain additional medical supplies.

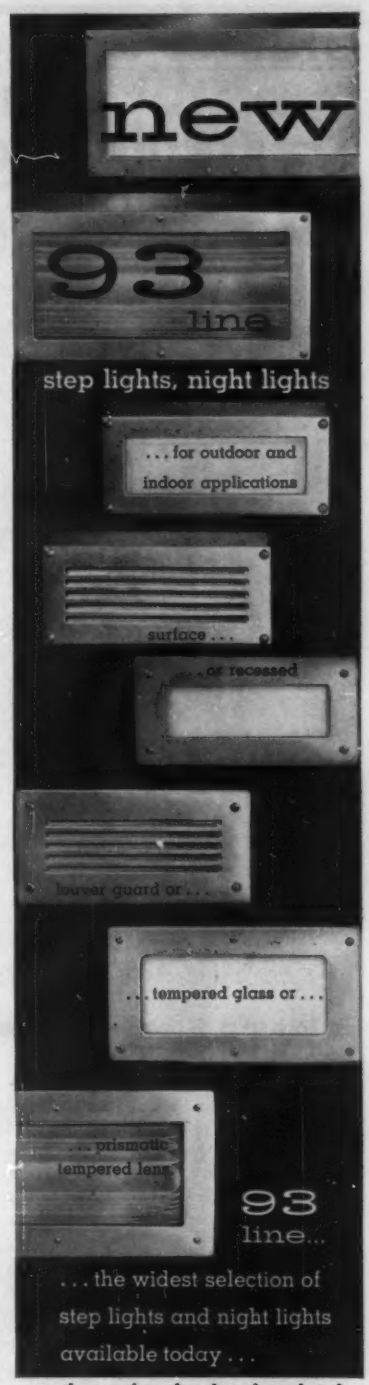
The Department of Defense proposes to conduct a nationwide technical "census" of fallout shelter spaces in existing structures, utilizing architect and engineering firms. Contracting agencies will be the U. S. Army Corps of Engineers and, where more convenient, the Navy Bureau of Yards and Docks.

As Congress set the stepped-up shelter program in motion, a four-week crash training program for instructors to guide and supervise the contract surveys was inaugurated at the Army Engineer School at Fort Belvoir, Virginia. The first contingent of 120 instructors, primarily civilian engineers employed by the Army and Navy, has graduated from the school. These instructors will train and consult with 1000 supervisory personnel of architect and engineer firms, who in turn will train their own engineers, possibly numbering 10,000, for shelter survey work.

Contracts will be awarded to qualified architect-engineer firms and self-employed engineers and consultants. These contracts will be awarded by existing district offices of the Army Engineers and local public works offices of the Navy Bureau of Yards and Docks. There are 38 Army and 12 Navy district offices scattered throughout the United States. The field office (Army or Navy) for each state will coordinate the administration of all contracts for surveys within the state.

The House Committee on Government Operations, which held extensive hearings on the new civil defense program, said prospective contractors will be required to demonstrate that their key personnel are professional engineers and registered to practice in their particular field. Members of survey teams must be technically qualified to collect and evaluate survey data.

"The decision to use professional architect-engineer firms," said

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# Greater strength—less bulk in KENNEDY'S Fig. 425

**125 lb. S.W.P. Bronze Gate Valves**

Fig. 425 Fig. 425SJ

**Rising Stem – Inside Screw – Wedge Disc**

Kennedy's Fig. 425 now provides the modern cylindrical body design which means greater strength with less bulk than other valves of the same rating. Rugged, wider hex ends blend into the body, prevent distortion, absorb wrench pressure. This is the proven design in the modern valve line for extra service life with less maintenance.

Screwed end valves are for use on steam, water, oil and gas lines. Fig. 425SJ, Solder Joint valves, are for use with types K, L and M copper tubing. With ordinary solder, (50% Lead—50% Tin) temperature must not exceed 250°F. A suitable brazing alloy should be used for higher temperatures.

Fig. 425 valves can be repacked under pressure, eliminating line shut-downs. Simply open valve fully, remove packing nut and repack. These valves conform to Federal Specification WW-V-54, Type II, Class A. They are available in sizes from ⅜" through 3".

*For complete details write for Bulletin 613.*

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the House Committee, "undoubtedly will bring about speedier and more uniform technical results than the alternative of training and utilizing local civil defense organizations or volunteer personnel."

The Congressional report declared that specially designed underground shelters are much more effective against radiation than existing or adapted aboveground shelters. Group shelters are more effective for survival and recovery than individual family shelters.

"Data developed by the U. S. Naval Radiological Defense Laboratory justify the estimate that a carefully planned system of underground shelters, fully equipped and stocked with food and other essentials, can be provided on a nationwide basis at a cost ranging between $50 and $100 per person. Adopting even the higher figure and making some allowances for unanticipated costs, we have a cost estimate of $20 billion."

**BPR Appointment**

Appointment of D. Grant Mickle, traffic engineering expert and former director of the Automotive Safety Foundation's traffic engineering division, as Deputy Federal Highway Administrator of the Bureau of Public Roads has been made. A native of Red Oak, Iowa, he received his degree in civil engineering from the University of Michigan in 1930.

Mickle has been with the Automotive Safety Foundation since 1943. During that time he has served as advisor or director for traffic surveys and studies in a number of states and cities throughout the country. In 1954 he served as a consultant to Melbourne, Australia on its traffic problems. From 1940 to 1943 Mickle was traffic engineer for the city of Detroit.

He is a member and past president of the Institute of Traffic Engineers, and holds membership in the American Society of Civil Engineers and the Am. Assoc. of Public Works Officials. ▲▲

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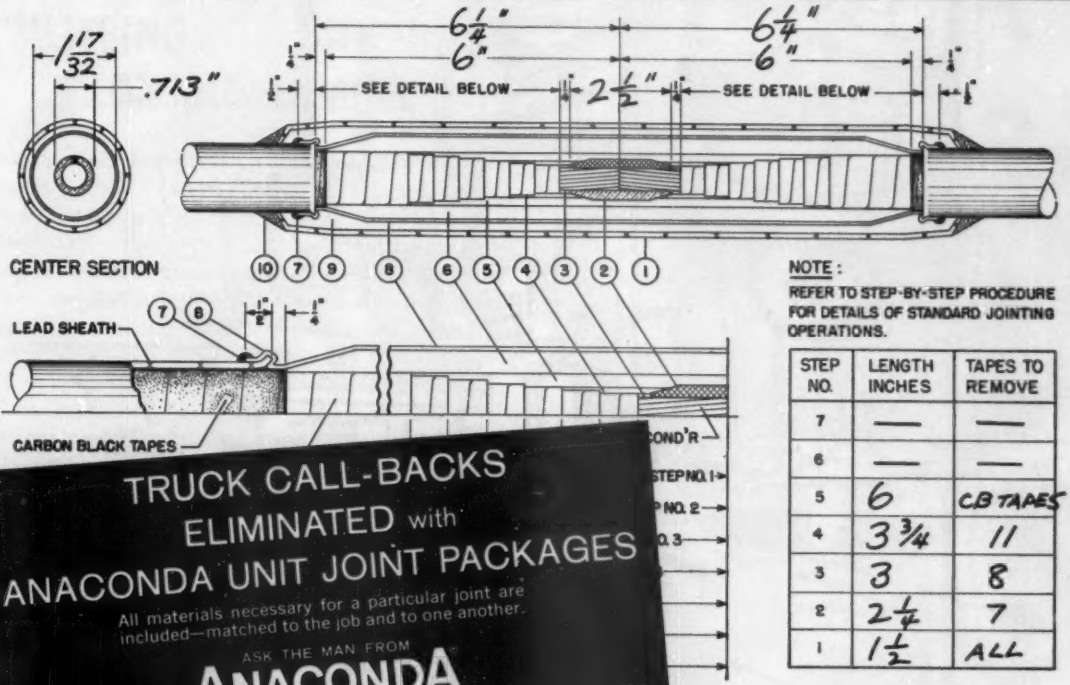


NOTE:
REFER TO STEP-BY-STEP PROCEDURE FOR DETAILS OF STANDARD JOINTING OPERATIONS.

| STEP NO. | LENGTH INCHES | TAPES TO REMOVE |
|---|---|---|
| 7 | — | — |
| 6 | — | — |
| 5 | 6 | C.B TAPES |
| 4 | 3 3/4 | 11 |
| 3 | 3 | 8 |
| 2 | 2 1/4 | 7 |
| 1 | 1 1/2 | ALL |


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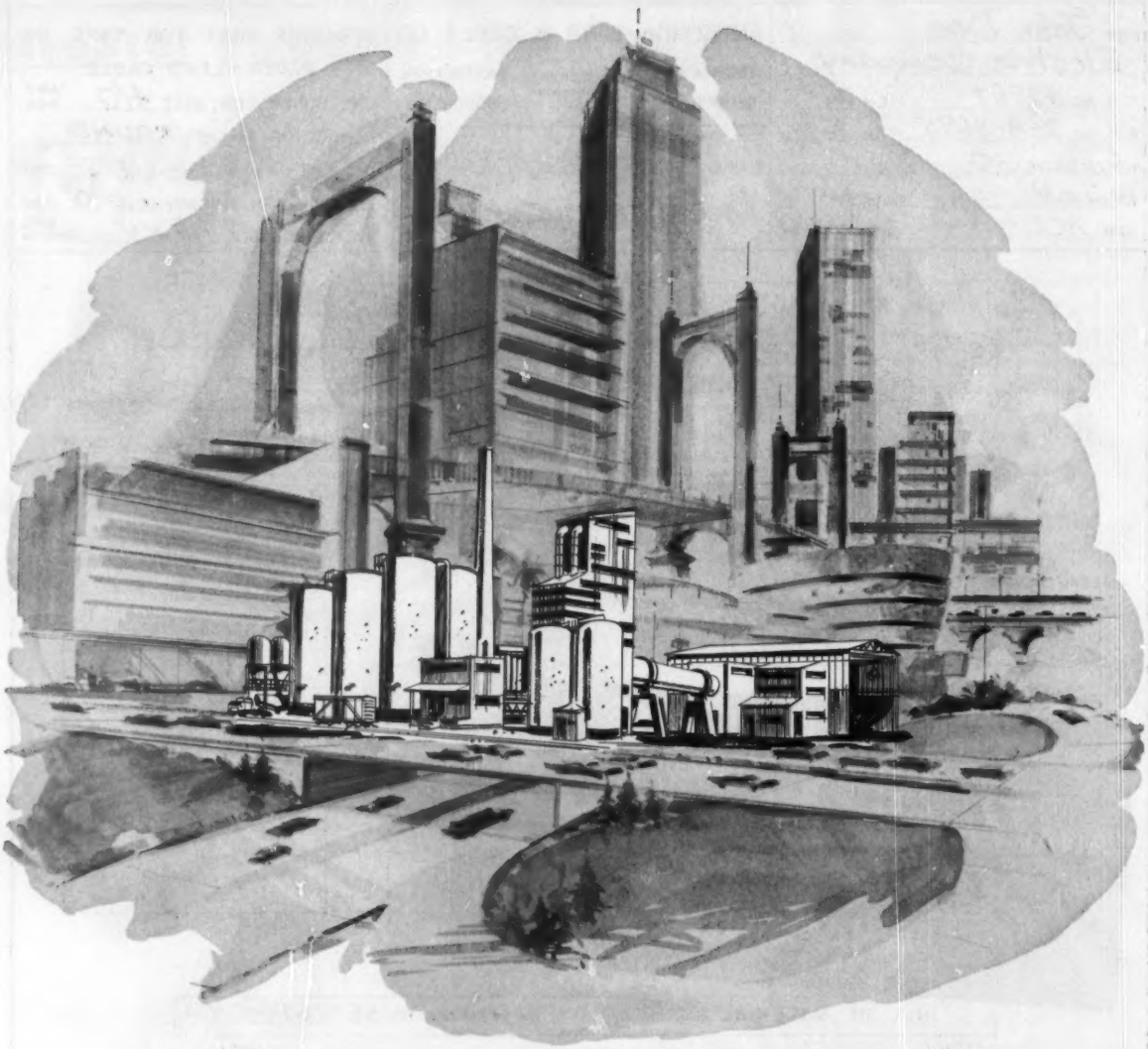
BILL OF MATERIAL CATALOG NO. 58111654-0-04

| ITEM NO. | DESCRIPTION | QUANTITY PACKED |
|---|---|---|
| 1 | LEAD SLEEVE 2" IN. I.D. x 16 IN. LG. x 8/64 IN. WALL | 1 |
| 2 | SPLIT TINNED COPPER CONNECTOR, SIZE 4/0 AWG MCM | 1 |
| 3 | V.C. TAPE, 3/16 IN. WIDE x 4 YD. PER ROLL | 1 ROLLS |
| 4 | V.C. TAPE, 1/2 IN. WIDE x 4 YD. PER ROLL | 1 ROLLS |
| 5 | V.C. TAPE, 3/4 IN. WIDE x 4 YD. PER ROLL | 2 ROLLS |
| 6 | V.C. TAPE, 1 IN. WIDE x 4 YD. PER ROLL | 9 ROLLS |
| 7 | BAR SOLDER | 1/2 LB. |
| 8 | COPPER MESH TAPE, 3/4 IN. WIDE x 6 YD. PER ROLL | 1 ROLLS |
| 9 | FILLING COMPOUND, NO. 150 SUPERSEAL | 2 PINTS |
| 10 | WIPING SOLDER | 2 LB. |
| 11 | FLUSHING COMPOUND, NO. 250 SUPERSEAL | 1 PINTS |
| 12 | STEARINE FLUX | 1 OZ. |
| 13 | PAPER PASTER | 4 |
| 14 | COTTON TAPE, 1 IN. WIDE x 3 YD. PER ROLL | 1 ROLLS |
| 15 | COTTON YARN 1/8 OZ. PER ROLL | 1 ROLLS |
| 16 | WASTE ENDS | 2 OZ. |

OIL PACKED IN #300 SUPERSEAL

17 ALOXITE CLOTH 1-1FT. ROLL



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*See Chemical Engineering Catalog for details and specifications.*

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Combustion controls tailored to your operation and completely integrated in a Superior Packaged Boiler provide a combination that's hard to beat.

Electrically operated positioning controls for steam or rotary burners are supplied either in console arrangement or free standing panel. Metering controls, either electrically or pneumatically operated, are supplied with steam atomizing burners of all capacities in free standing panels which may be individual for each boiler or combined for two or more boilers.

Safety combustion controls are an integral part of every control panel. Complete factory wiring terminates in a boiler junction box with terminal strip matching identical strip in control panel.

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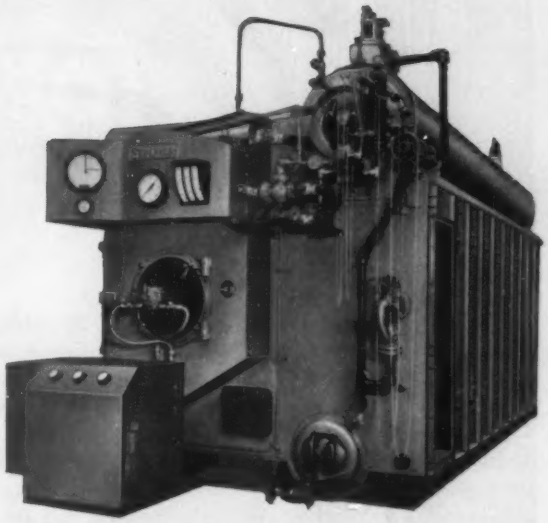
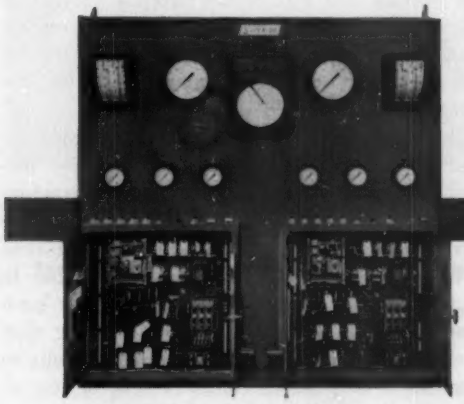
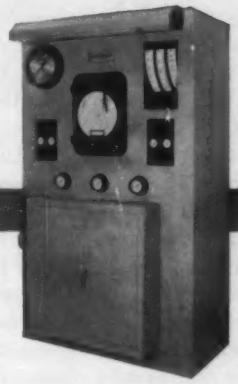


"Type D" Superior Packaged Boiler with integral console for single burners and electric positioning controls.



Duplex panel for two boilers with recording, indicating instruments and individually wired cabinets for combustion safeguard controls.

Control panel with indicating instruments for either rotary cup or steam atomizing burners with positioning controls.



Control and instrument panel with pneumatically operated metering controls for steam atomizing burner installations of all capacities.

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From the Editor's

# Tranquil Tower

## They Say It's Murder!

THIS YEAR, the National Association of Plumbing Contractors completed a rather extensive survey on the subject of architects' and engineers' specifications and contract documents. A report was published – with considerable fanfare – in the contractors' publication *Plumbing, Heating, Cooling Business*. It is only small comfort to note that the architects bore the brunt of the contractors' criticism, for the consulting engineers were not neglected. There is ample evidence that the murder clause is still a potent weapon in the hands of the cagy architect or engineer.

Whether or not there is a cause and effect relationship, it is worthy of note that the AIA has recently made available important revisions of its General Conditions of Contract for the Construction of Buildings. Actually, AIA began this project some time ago, but many architects agree that the major result of the changes is to give some relief to the contractor. Whether similar revisions are in order for the Consulting Engineers Council General Conditions remains to be seen. At this time, they are probably too new to have had any really significant impact on the construction industry – although there are already some plaintive grumblings from some quarters and compliments from others.

There is general agreement in the construction industry that murder clauses can be categorized under three headings.

¶ Ambiguous language – You said it; do you really mean it?

¶ Direct shift of responsibility – You designed it; why don't you guarantee it?

¶ Unreasonable contract terms – The boiler has been operating for six months; why does the guarantee start tomorrow?

Though some contractors seem to agree that consulting engineers deliberately use ambiguous language, we doubt that this is a common practice. The double talk technique is not even a good gimmick for the sharp tongued lawyer, since it has a way of backfiring. However, consulting engineers ought to make a practice of limiting the use of such words as "complete," "satisfactory," "necessary," and "fully automatic." This does not necessarily mean that specifications need to grow longer – just clearer. And, the contractors imply, there would be fewer words required if engineering drawings were more complete.

When the consulting engineer shifts the responsibility for the performance of a system he has designed onto the contractor, there can be no question of intent. This is the tool of the weak engineer, and the fact that he can find a contractor stupid enough or reckless enough to bid under these conditions merely compounds the felony. It may take a lot of guts for the contractor to refuse to bid, but that is the obvious solution.

Though consulting engineers may sometimes be guilty of unreasonable contract terms, they frequently have good cause. For example, contractors complain about excessive retention of payments despite performance bonding. The skittishness of consulting engineers in this area is understandable in view of the fact that some bonding companies have been ducking their responsibility by claiming that the consulting engineer has allowed overpayments to the contractor who is in default. There is, of course, no excuse for the traditional "hold harmless" clauses and the vague definitions of guarantee periods.

Essentially, the murder clause persists in contract documents as the last resort of the incompetent engineer or as a shaky defense against the unscrupulous contractor. Neither of these groups could exist except for the fact that consulting engineers and contractors too frequently nurse their ancient tradition of mutual animosity and get together only under duress. That the murder clause is still with us is ample evidence of their failure to establish a basic working relationship. Until they do – it's murder!▲▲

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Architects & Engineers: Maurice H. Connell & Associates, Miami, Florida
General Contractor: Henry C. Beck Company, Palm Beach, Florida

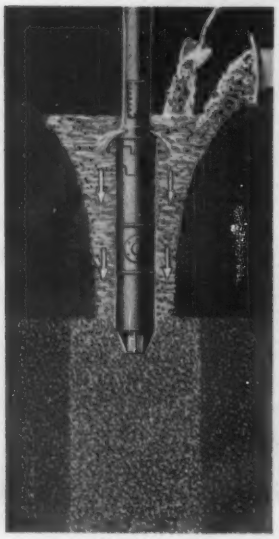

*Diagram shows the lower end of a Vibroflot® machine in action to presettle sandy soil. Compaction is accomplished by a simultaneous saturation and vibration of the granular materials involved. During the application, fresh sand is added at the surface to compensate for the loss in volume caused by the increase in density (bearing capacity) of the compacted soil.*

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About 7000 cu. yds. of fresh sand were added during compactions to an average depth of 28 feet to achieve a uniformly dense foundation.

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# Heard Around Headquarters

MARJORIE ODEN, Eastern Editor

### Annual AASHO Meeting

At its annual meeting in Denver recently, the American Association of State Highway Officials announced a policy statement that "Urban portions of the Interstate System should be planned and developed by state highway departments as urban extensions and connections of the over-all highway network, in cooperation with appropriate local governments and interested federal agencies."

This position is included in a policy statement on highways in a national transportation policy, developed for inclusion in a comprehensive report which was scheduled for submission to President Kennedy last month.

Also at the AASHO meeting, a proposal that a joint committee of AASHO members and the Engineering Division of the American Road Builders' Association be established was voted down by AASHO. The committee had been advanced as a possible forum for discussion of highway design and administration problems.

### New ACI Chapter

A new chapter of the American Concrete Institute has been formed in Hawaii, with a consulting engineer as its first president. Altred A. Yee, president of Alfred A. Yee and Associates, of Honolulu, is president of the Hawaii chapter. This is the fifth local group to be chartered by ACI since February of 1958, when the Institute sanctioned the formation of chapters as a means of expanding activities on the local level.

### No Merger

There will be no merger of the Engineers Council for Professional Development and the Engineers Joint Council. Approval of two-thirds of the ten ECPD member organizations was necessary to rati-

*Colorado consultants C. Johnson, R. Andersen, E. Konkel, E. Waggoner, and A. Swanson discuss with Governor McNichols a plan to give more state work to CEs.*

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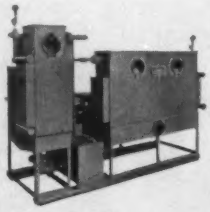

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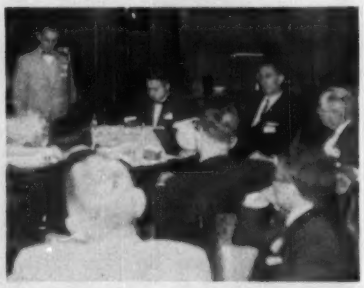
fy the proposed merger. The final vote was five in favor, five against.

The voting scoreboard showed the American Institute of Mining, Metallurgical and Petroleum Engineers; the American Society of Civil Engineers; the Engineering Institute of Canada; the American Institute of Chemical Engineers; and the American Society for Engineering Education, in favor of the merger. (The latter voted a "qualified" yes; most of the qualifications concerned the mechanics of carrying out the merger).

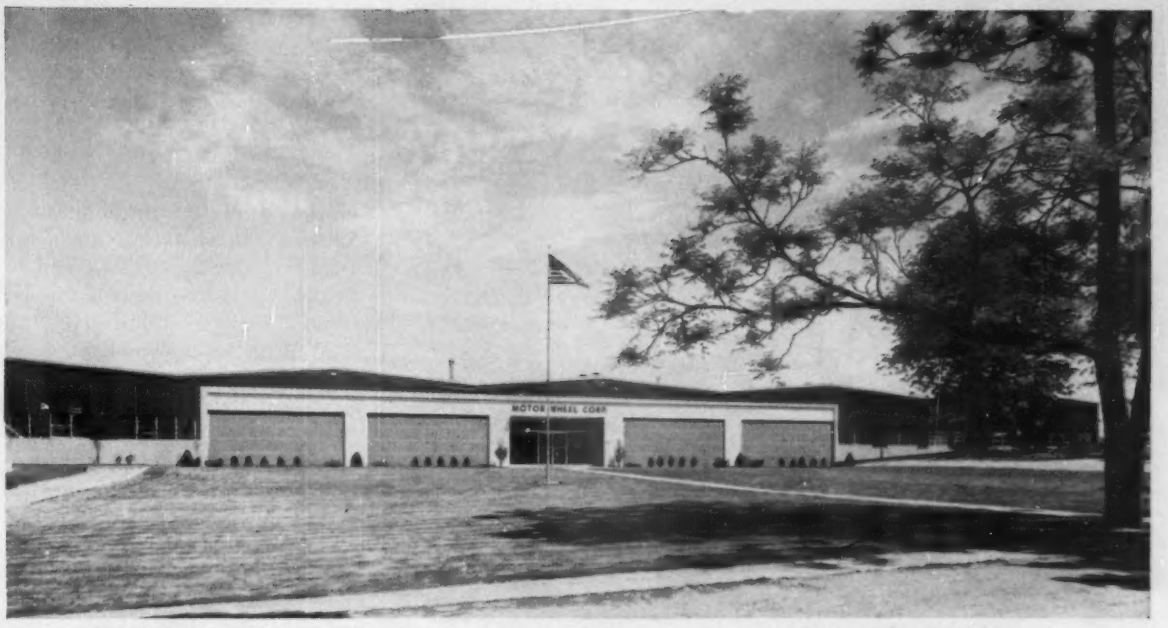
Against the merger were the American Society of Mechanical Engineers; the American Institute of Electrical Engineers; the National Council for State Boards of Engineering Examiners; the Institute of Radio Engineers; the Institute of Aerospace Sciences.

**Government Personnel Policy**

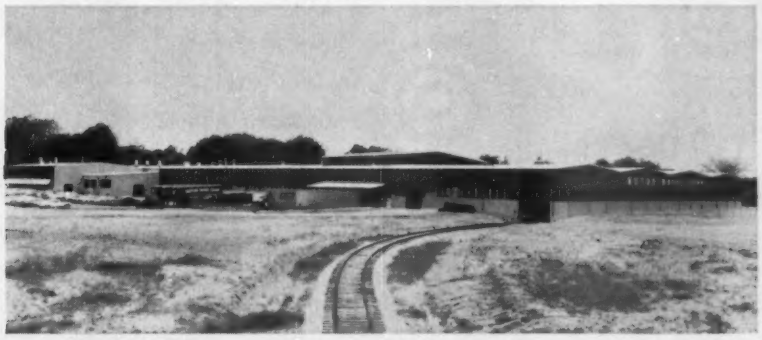
The National Society of Professional Engineers has urged President Kennedy's Special Task Force on Employee-Management Relations to provide all organizations with equal opportunities to discuss Federal personnel policy with government agencies. The NSPE was particularly anxious that the Task Force avoid any recommendations that would confine the rights of such discussion to labor organizations or unions. It was pointed out that professional organizations ordinarily will represent professional



*General chairman Ralph Abramson outlines the purposes and goals of a code seminar held recently at the Chicago Engineers' Club. Some 70 persons attended the seminar, held by Chicago Association of Consulting Engineers.*



*The 121,000-sq.-ft. Motor Wheel Corporation building at LaGrange, Indiana, is a well designed production tool and a real asset to the community. In addition to colorful, low-profile beauty, such features as overhead offices and storage to save floor space, plenty of room for overhead equipment attached directly to the steel framing, and custom-designed facilities for shipping and receiving were specially incorporated to meet Motor Wheel's particular needs.*



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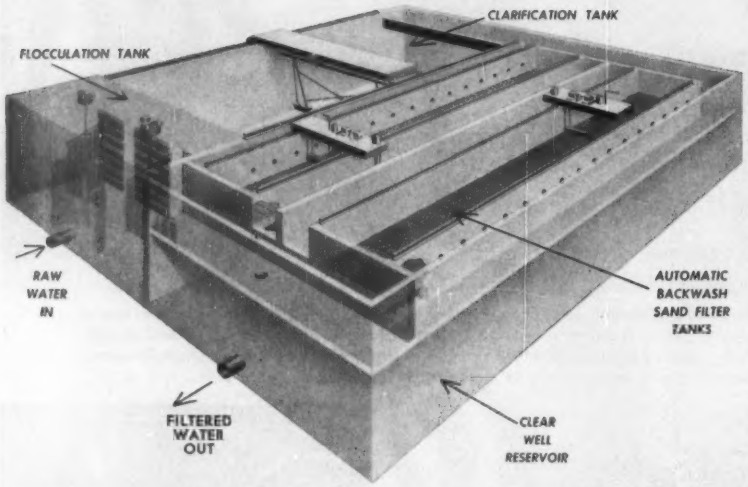


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groups more effectively than will labor unions, or organizations with mixed professional and labor membership.

### AIEE-IRE Merger

The boards of directors of both the American Institute of Electrical Engineers and the Institute of Radio Engineers have passed a resolution, forming a committee to study plans for a consolidation of the two groups. The joint resolution points out that "the advancement of . . . electrical and radio engineering, and the . . . objectives of both Institutes may be better served by . . . consolidation . . . ."

The proposed new group would have a membership of about 150,000 engineers, scientists, educators, and industrialists. The study committee will present its first report on the feasibility of the merger sometime next February. If approved, the merger will be scheduled to go into effect early in 1963.

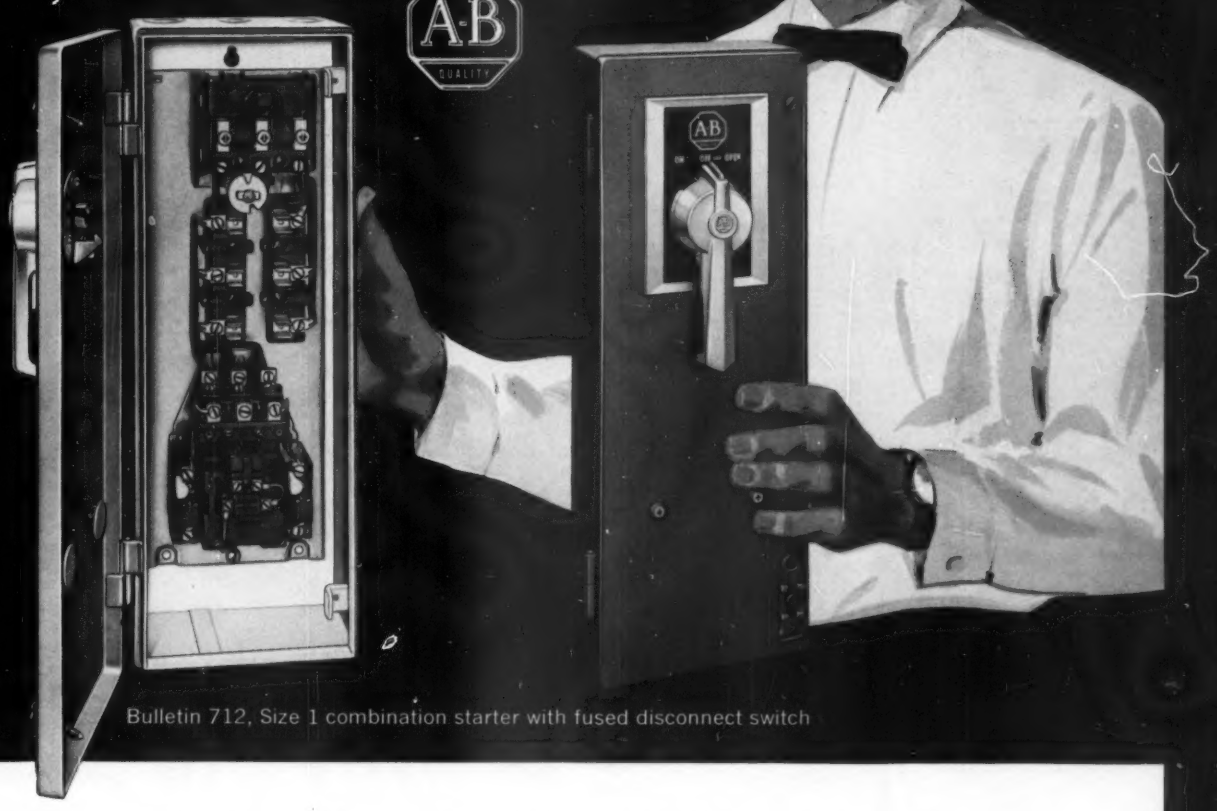
### Study of Canons

For some time, there has been criticism of the Canons of Ethics on the basis that they do not cover the ethics of the employee engineer. The Engineers Council for Professional Development now is taking another look at the Canons.

The member organizations have been asked to affirm that the Canons of Ethics should be considered the foundation of the entire profession's ethics. "They should be similar to the constitution of an organization. Amendments or revisions should be made as required by changing times, but only after thoughtful consideration."

After agreeing on the ground rules, the member societies are requested to reaffirm their adoption of the Canons; review their own Code or Rules to assure conformity with the Canons; rewrite, if necessary, the separate Code or Rules so they clearly constitute supplements to the Canons; suggest amendments or revisions; and advise the ECPD Committee chairman of action taken. ▲▲

# Let me tell you why these NEW BULLETIN 712 and 713 Combination Starters should interest you!



Bulletin 712, Size 1 combination starter with fused disconnect switch

## They have — Smaller Size...Greater Switching Capacity... Greater Reliability...Longer Life...Complete Safety... Generous Wiring Room...Simple Design...Businesslike Beauty

Rating for rating, the new Bulletin 712 motor starter will outperform and outlast all others. Complete safety for the operator is assured because the cabinet door cannot be opened until the lever is moved to the OPEN position, which opens the visible contact disconnect switch.

The Bulletin 713 combination starter provides similar features for complete safety, but uses an ITE circuit breaker as a method of disconnecting.

Brooks Stevens, famous industrial designer, has given the entire line of enclosures, an undeniable "eye appeal"—an asset to any modern machine tool or industrial installation. Please write for details, in Publication 6100: Allen-Bradley Co., 1316 S. Second Street, Milwaukee 4, Wis.

**BULLETIN 713**
Combination Starter with Circuit Breaker in Nema Type 1 Enclosure.

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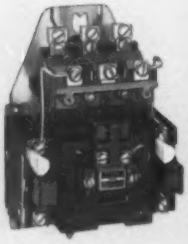
combination starter with fused disconnect switch in Nema Type 1 enclosure.

The new A-B Series K starter and new A-B disconnect switch in a single enclosure provides complete safety for the operator and the production machine — because the cabinet door cannot be opened until the disconnect is OFF. Also, this "safer" combination starter costs less to install than a separate starter and disconnect switch. There is a neatness about such installations—it is the mark of being up-to-date! Publication 6100 will supply you with complete details—better write for it today: Allen-Bradley Co., 1316 South Second Street, Milwaukee 4, Wisconsin.



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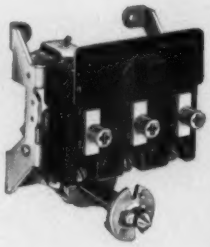
The new Series K starters have been completely redesigned for many *more millions* of trouble-free operations. The new magnet is cushioned to reduce wear. The new molded coil is protected against all harmful atmospheres. The new weld-resistant contacts close without wear-causing sliding motion.



## Visible Contact Disconnect Switch

When the front-operated disconnect switch is in the OPEN position, all three contacts are clearly visible as being open. An easily removable insulating guard prevents accidental contact with the incoming lines. The double-break, silver alloy contacts operate with positive snap action.

## Safety Cover Latching

The door of the enclosure can be opened *only* when the disconnect switch is in the OPEN position. However, it may be opened by *authorized* personnel while the disconnect is closed by means of a hidden defeater screw. Incidentally, this defeater can be made inoperative.

## Extra Safety Padlocking

The operating handle can be locked in the OFF position with as many as three padlocks. When desired, means to lock the disconnect switch lever in the ON position can be provided. In addition, the enclosure door can be padlocked closed, with the handle free to be operated.

**Can also be supplied as Bulletin 713 combination starter with circuit breakers**

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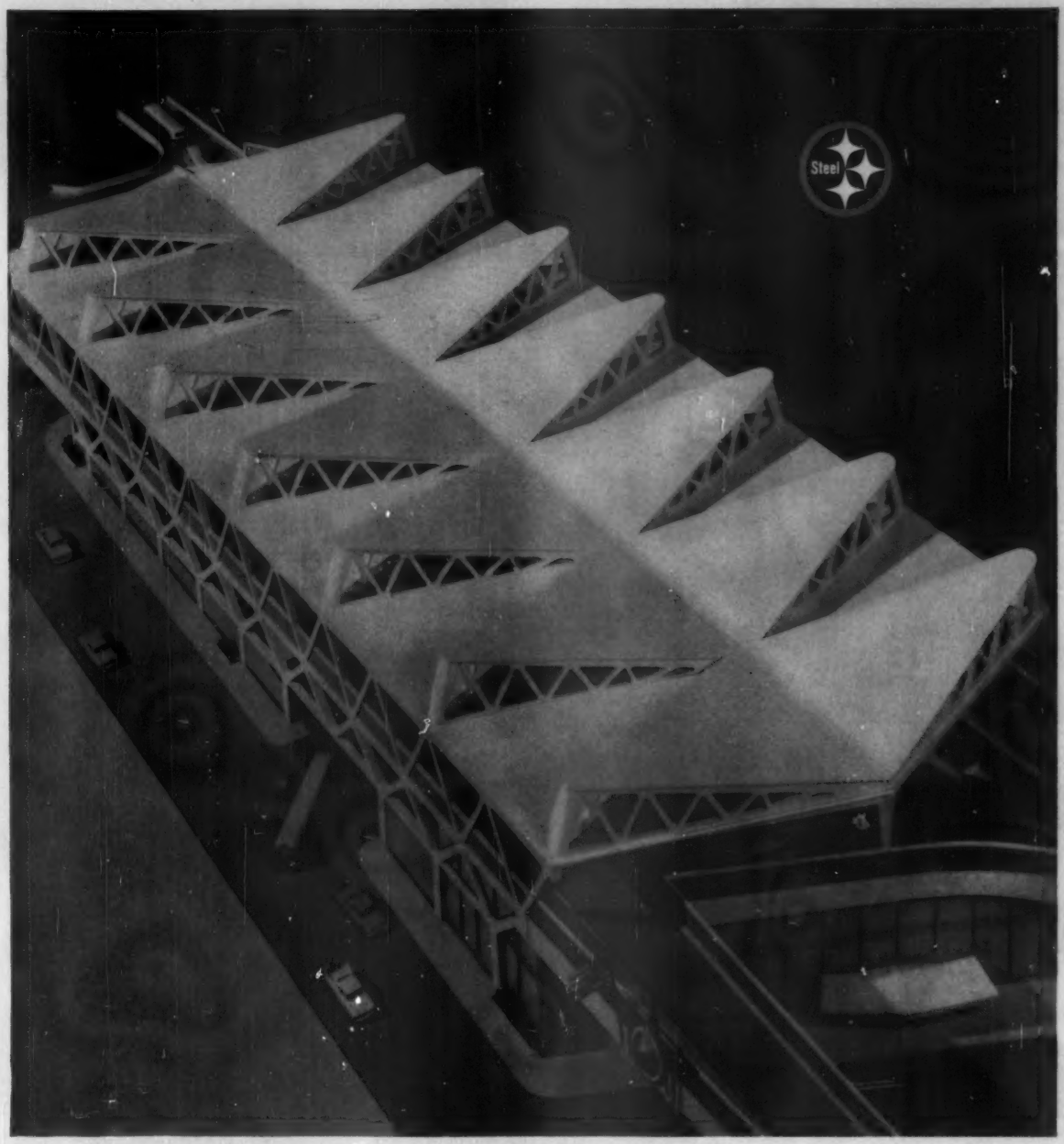


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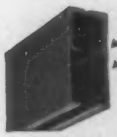


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DR. MELVIN NORD
Registered Engineer
Attorney at Law


## Experimental Evidence

ODELL v. FREUH, 146 Cal. App. 2d 504, 304 P. 2d 45, 76 ALR 2d 345, was an action for breach of express and implied warranty, brought by the buyer of an antialkaloid product against the seller-manufacturer.

### Background

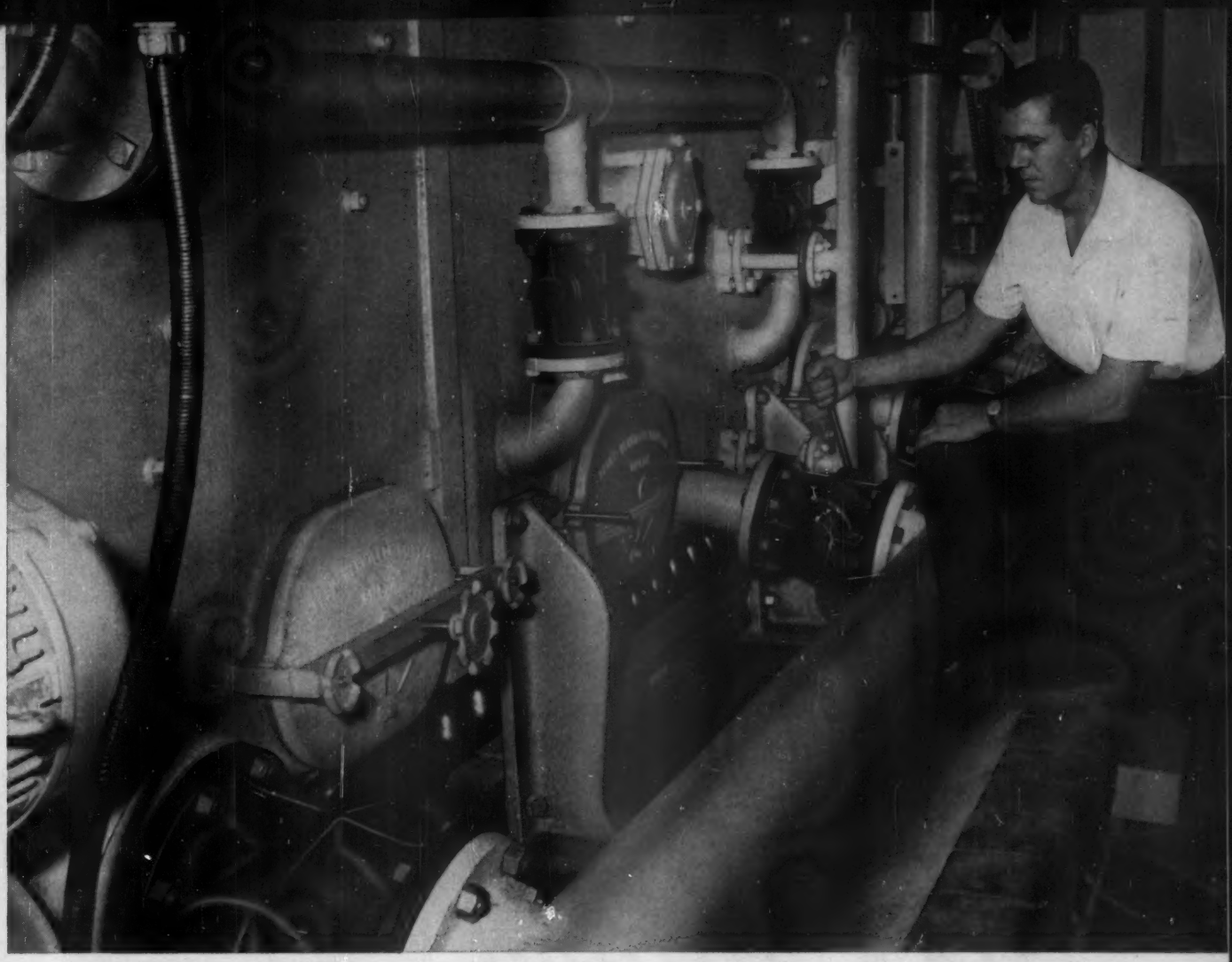
The Glendale Unified School District planned to construct an elementary school building, using the tilt-up method of construction. A slab of concrete was laid as the floor of the building, an antibonding agent was applied, another slab of concrete was laid on top of the floor slab, and successive slabs then were constructed in layers. After all the slabs were poured, the top layers were to be tilted up on their ends to form the walls of the structure, leaving the floor slab on the foundation.

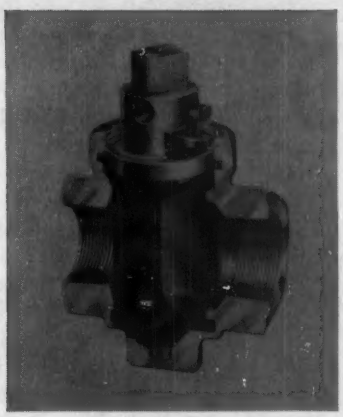
Having learned of the planned building activity, Freuh contacted the authorities of the school district, and suggested that the "Ashford Formula," which his company manufacturers, be specified for application upon the concrete floor of the proposed school — in order to prevent the formation of alkali beneath floor covering material and as a cure for new concrete. Advised that the tilt-up method was planned, Freuh assured the district's officials that the formula would not be harmful to any of the surfaces with which it might come in contact, and could be used to advantage with the tilt-up method.

When the school district informed the firm of architects retained to draw the plans and specifications for the new building that the "Ashford Formula" should be specified, a member of the firm contacted Freuh for further information. The architects had not had prior experience with the use of this product. They were advised that the product had been used successfully by the company on previous construction projects which involved tilt-up construction; that it would in no way interfere with the action of the antibonding agent to be applied between the successive slabs to prevent adhesion; and that it should be applied under the strict supervision of the manufacturer; and that it should be applied just as the newly laid concrete begins to harden. The architects relied on this information and specified that the product be used.

### Cause of Action

During the construction of the building, the formula was applied by Freuh to the floors of a portion of the construction designated "Unit A." The formula was not





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applied to concrete for the flooring of "Unit B." An antibonding agent was applied between the layers of poured concrete on each unit. When the time came to tilt up the slabs, those on Unit B lifted easily. However, the layer directly upon the floor of Unit A, to which the formula had been applied, adhered and would not tilt. All the slab was damaged and a portion destroyed.

The court held that the evidence offered was sufficient to establish a breach of warranty. The principal point of interest to consulting engineers is the type of experimental evidence offered in support of the above direct evidence.

### Experimental Evidence

The plaintiffs introduced into evidence the result of a certain experiment. Two test slabs of concrete had been poured at the job site under the direction of a research laboratory. One was coated with the Ashford Formula, the other with the same bond-breaker used in the construction of the school. The same bond-breaker was later applied to the slab treated with the formula. Another slab was poured on each treated slab. The slab treated with Ashford Formula adhered to the concrete poured upon it. The conditions under which the test was conducted were the same as those which prevailed during the construction of Units A and B, except that the climatic conditions were not identical, since some months had intervened; a slightly larger gauge reinforcing steel was used in the test slabs; and two coats of Ashford Formula were applied in the test, while it is not clear whether two coats were used during the actual construction.

On appeal, it was held that the trial court properly exercised its discretion in admitting this experimental evidence, despite the fact that exact identity of conditions did not prevail. The court said: "The conditions surrounding the test were sufficiently similar to those prevailing at the construction of the classroom units to enable the trier of fact to consider the result of the experiment in determining the cause of the adhesion of the concrete slabs and assign to it whatever weight was merited."

The question of experimental evidence is treated fully in an Annotation in 76 ALR 2d 354. The general principle deduced from an analysis of many cases is that experimental evidence ought to be admitted if it tends to enlighten rather than mislead the jury. The earlier concept that experimental evidence was inadmissible on the ground that parties could manufacture evidence in their own behalf now is apparently overcome. The Annotation cited presents a collection of cases dealing with the following subjects, among others: inflammability, explosiveness, suitability of building materials, tensile strength, and slipperiness. ▲▲


# Who's Who

The first edition of "Who's Who in Certified Performance Ratings" is now available to users and specifiers of air moving equipment. This new publication of the Air Moving and Conditioning Association meets the recognized need for an official directory of manufacturers and products licensed by AMCA to use the Certified Ratings Seal.

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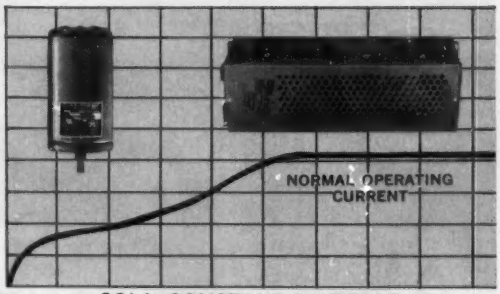


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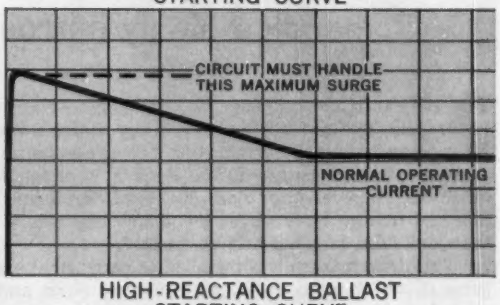


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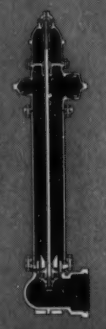

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MARJORIE ODEN, Eastern Editor

# NSPE At Roanoke

Field Notes

MEMBERS of the National Society of Professional Engineers will be requested next month to vote on the future possibility of having nonregistered persons as "Engineer Members," in the interest of furthering the Functional Plan for Unity. Under the Functional Plan, all professional matters would be handled by NSPE, all technical matters by Engineers Joint Council, and education by the Engineers Council for Professional Development. An "umbrella organization" would be formed to coordinate the three groups.

At a meeting in Roanoke, members voted without dissent to put the question of nonregistered members to a ballot. A two-thirds majority of the votes cast is needed in order for the necessary constitutional changes to be made.

Under the NSPE proposal, nonregistered engineers of approved engineering societies (such as Fellow grade members of the American Society of Civil Engineers) would be given membership in NSPE, provided those societies require that all future members admitted to such grade be registered professional engineers.

This would apply to the five Founders, or to "any other national engineering society which, in the opinion of the National Society board of directors, as expressed by a two-thirds vote of those present at any regular meeting of said board, has as its objectives the advancement of a branch of engineering; whose voting membership consists of at least 50 percent graduate or registered engineers; has membership requirements equivalent to the membership requirements of the Engineering Founder Societies; and has a grade of membership for which the admission requirements after a specific date include the holding of a valid license or certificate of registration as a P.E."

The nonregistered men would be "Engineer Members." NSPE would continue to require registration for the "Professional Engineer Member," grade just as in the past, and eventually the new "Engineer Member" grade would be eliminated as technical organizations raised their admission standards.

As things now stand, the only Founder whose members could join NSPE under this plan is ASCE — which has come out on numerous occasions for unity through EJC, not through the Functional Plan which the NSPE ruling is aimed at advocating. However, it is likely that ASME also may be eligible soon.

### Unified Principle

As a part of the unity program, the NSPE board also endorsed "A Unified Statement of Principle by AIEE, ASME, and NSPE in the Interest of the Improved Organi-


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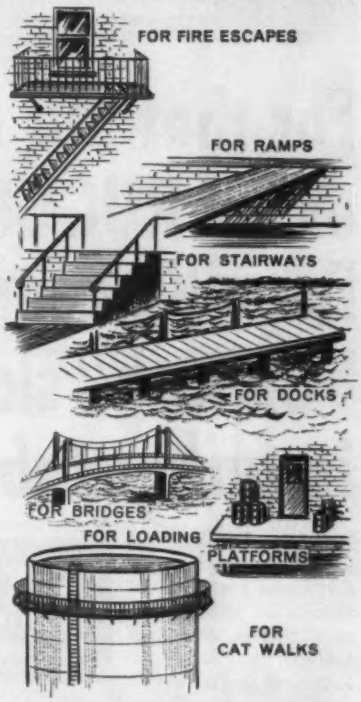


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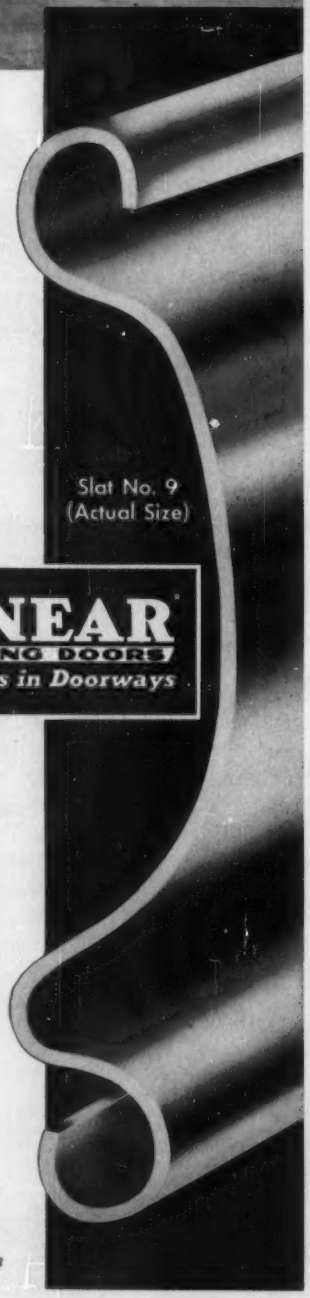


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zation of the Engineering Profession." Four major points in the Statement are:

"1. The basic principle and the division of areas of responsibility (technical, educational, and professional) encompassed in the functional concept are sound, and should be implemented by engineering societies intent upon improving the organization of the engineering profession.

"2. In the implementation of the functional concept, an integrating body is desirable not only as a mechanism for assuring understanding among domains, but as an outward symbol of unity within the profession.

"3. The chief responsibility of ASME and AIEE to their members lies in the technical domain. Although not obliged to relinquish any services now offered their members, these societies should restrict their activities outside the technical area and should participate in the coordination of broader matters with other appropriate groups.

"4. Complete acceptance of the functional concept by an individual engineer necessitates his membership support of both a technical society and a professional society. Each society should urge such dual membership . . ."

This report, which is expanded to about three pages, also states that "The ASME and the AIEE have under consideration at the moment the establishment of professional registration as a requirement for the grade of Member. NSPE also has under consideration a plan to permit admission, for a limited period and with certain restrictions, of nonregistered engineers who are now Members of qualified societies."

The ASME executive committee has approved the joint statement, and was scheduled to present it to the Council "with recommendation for approval" late last month. If the ASME Council approves the idea of requiring registration for

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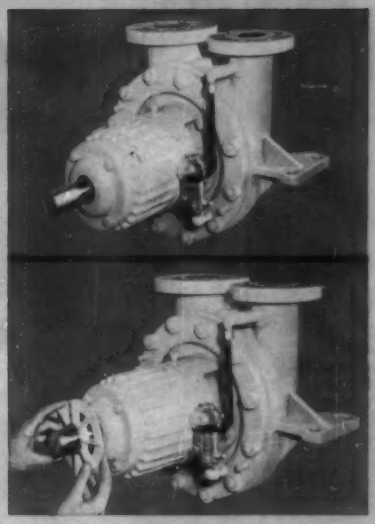

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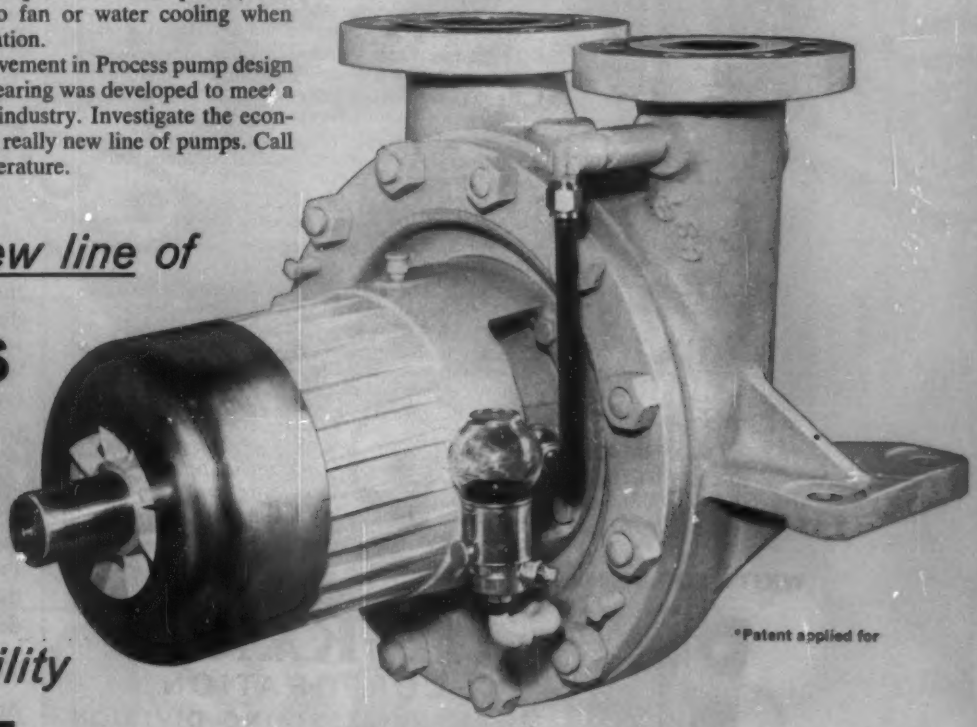

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full membership in the future, this too would have to go before the membership, since it involves a constitutional change.

However, the statement that AIEE also is considering requiring registration for membership is a little on the optimistic side. According to an AIEE official, that organization has no plans whatsoever to require registration of future membership, and in view of the proposed AIEE-IRE merger (See Heard Around Headquarters, Page 31), any consideration of change in AIEE membership requirements would, at best, be delayed for some time. The official added that AIEE probably would approve the joint statement "in principle," but would insist on "quite a few editorial changes first – including omission of the paragraph about AIEE considering the establishment of professional registration as a requirement for the grade of Member."

**Other Actions**

In other actions, the NSPE board and the Functional Section for Consulting Engineers went on record against the proposed "Division of Responsibilities" report prepared and now being considered by the EJC-AIA joint committee.

As Leigh St. John explained, "This report would have a serious affect on court cases pending in New Jersey and in Ohio. I believe the report is based on a policy of destruction by division. According to this report, architects should be coordinators on any general building projects. The report also places planners on an equal basis with engineers. If this report were adopted, an engineer could not attempt to supplant even an unqualified planner on a project." President Murray Wilson explained that AIA has been requested to delay distribution of the report.

**The Functional Section**

At the Functional Section meeting, it was announced that a meet-

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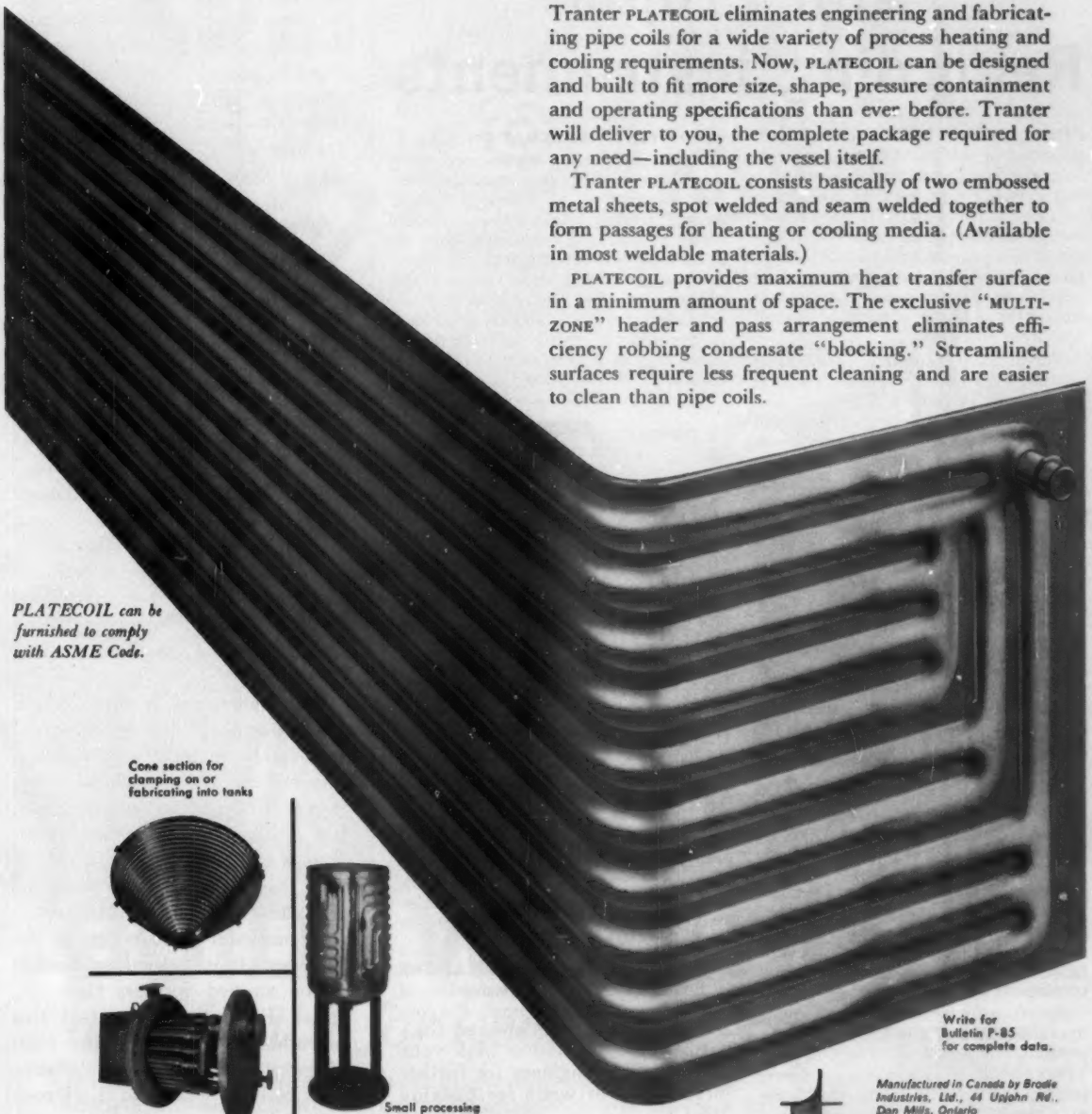

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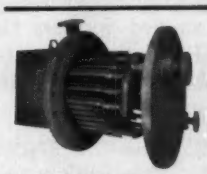

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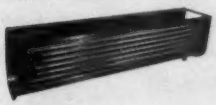

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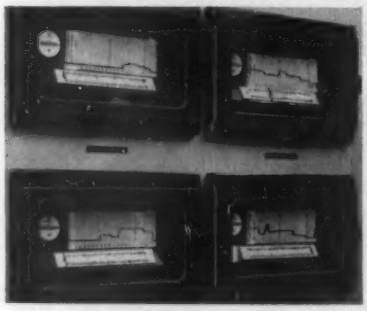
**heat transfer specialists**

SPARLING METERING TOPICS

# Better Flow Records with Proper Recording Instruments

PERMANENT RECORDS of flow provided by adequate instrumentation in any metering installation enable water works engineers to conduct a continuous study of daily production, overall consumption, variations in demand and seasonal fluctuation. Accurately recorded information makes it possible to control flows and anticipate trends for a higher degree of overall operating efficiency.

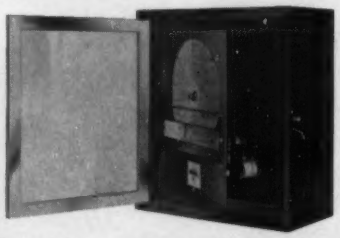
For modern, complete, centralized control, every meter in a distribution system and in process functions may be monitored at one location reducing the need for on-the-spot checks of remote installations.



There are many different types of recording instruments. Sparling has available mercury governor bowl instruments which are ideal where a limited flow range exists; 12" differential circular chart instruments suitable for wide flow ranges; and horizontal strip chart instruments—either full size or miniature—which provide permanent records of from 60 to 120 days continuous operation.

Sparling instruments have varying operating ranges from 5:1 to 20:1, depending on the specific need. Regular 110/120 volt, 50 or 60 cycle a.c. power supply is normally adequate. Some may also utilize mechanical control.

**READY FLOW INFORMATION**...Each Sparling instrument is equipped with an indicator which gives instantaneous flow information, as well as a 6-digit straight reading totalizer that reads directly in standard volumetric units to show total flow at a glance. Sparling instruments offer a wide range of application to meet almost any flow recording requirement and are produced in designs for either wall or panel mounting, as well as in self-contained consoles.



**FLEXIBILITY**...Many variations of Sparling Indicator-Totalizers supplement the permanent recording instruments to provide almost unlimited possibilities of use to give any metering installation the benefits of good instrumentation.

**AUXILIARY CONTROL**...In addition to maintaining continuous accurate records, instrumentation permits effective controls to be incorporated in systems that can eliminate the guesswork involved in manually operated pumps, valves, chemical feeders and other auxiliary equipment.

**COMPLETE METERING INSTALLATIONS**...Sparling builds an extensive line of main-line meters, instruments and controls to offer a complete and compatible metering system. **Ask your Sparling field engineer for further information or write for Catalog 315-CE.**

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ting with Federal Highway Administrator Rex M. Whitton was scheduled tentatively for late November. "It is felt that certain provisions of Bureau of Public Roads General Memo 40-6, setting forth BPR policy for approving engineering service contracts, have been improperly interpreted in the past by field offices and should be revised to prevent further misunderstandings." They also expect to discuss the problem of competitive bidding on surveying contracts with Whitton.

"In a related action, the Functional Section has been requested to supply information for a congressional committee regarding the policy of state highway departments on the use of consulting engineers. Accordingly, state societies have been asked to contact their state highway departments to fulfill this request." Replies are being compiled, and the Functional Section hopes to have a summary of highway department policies (when the departments have policies or will state their normal procedures for retaining consulting engineers) for presentation to the Congressional Committee in January, 1962.

The Functional Section (which is thinking about finding a new and less cumbersome name) also announced a series of regional meetings will be held as soon as possible to discuss more localized problems of consulting engineers. NSPE now has functional sections for consulting engineers in 28 states.

A proposed amendment to the highway bill was discussed, and is to be studied further. However, some of the members felt the amendment would require state highway departments to justify their costs, as well as to check consultants' fees.

The proposed amendment states:

"The Secretary (of Commerce) shall determine the reasonableness of (1) all land acquisition costs, by separate appraisal if he determines it to be advisable, and (2)

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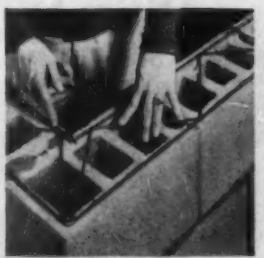
- Dur-O-wal Ltd., 789 Woodward Avenue, HAMILTON, ONTARIO, CANADA



*Strength with flexibility—the two basic factors for a repair-free masonry wall are assured by these engineered companion products. Dur-o-wal reinforcement, top left, increases flexural strength 71 to 261 per cent, depending on weight Dur-o-wal, number of courses, type of mortar. The ready-made neoprene Rapid Control Joint, beneath, flexes with the wall, keeps itself sealed tight.*

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Corrosion is expensive. It increases operating costs. It requires additional maintenance and reduces plant operating efficiency. And, previously, as the temperature of the fluids or gases being handled increased, expensive alloy and non-metallic piping systems were required.

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Widely varying conditions including temperature, pressure and concentrations of fluids or gases being handled require each proposed piping system to be carefully selected. Should any questions arise, Tube Turns Plastics' engineers will be happy to consult with you on your corrosion problems. For additional information, call or write today.

**TUBE TURNS PLASTICS, INC.**

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*Mark of progress in industrial plastics piping*

For quick, easy joining of "Penton" pipe, fittings and valves, the new THERMO-SEAL* heat tool produces permanent, leakproof joints that are stronger than the pipe itself. By placing the units to be joined on the tool, heating and then assembling, the joint is completed and ready for use in a matter of seconds. See it in action. Consult your nearby Tube Turns Plastics distributor today.

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*"Penton" is a trademark of Hercules Powder Co.

engineering costs, submitted as part of the costs of any project and no part of any such costs in excess of that determined to be reasonable by the Secretary shall be considered a cost of construction for the purposes of this title."

Also at the meeting, the NSPE Board considered:

¶ Money — the adopted budget is larger than the anticipated income, so it was pointed out that something is going to have to give.

¶ Scholarships — a tax-free organization was established a year ago to administer the ARMCO scholarships, and NSPE would like to get more engineering scholarships for the group to handle.

¶ Unions — the New York State Society of Professional Engineers requested $5000 to help combat Mayor Wagner's executive ruling granting unions exclusive bargaining power for city employed engineers. The request was denied, but the New York State group was assured of moral support.

¶ Ohio — the Ohio Society is upset over the national trend to accept the Davis-Bacon Act ruling as including survey crews. Under this act, all except the crew chief would be classified with workers whose wages must be certified. In Ohio, the attorney general has ruled that surveyors' duties are professional in nature.

¶ Uniform Telephone Listings — the Ethics Committe has completed a survey of 800 consulting engineers and 800 "other" engineers to learn their preference in yellow page listings. NSPE hopes to work with ASCE and CEC in making a presentation of these findings to American Telephone & Telegraph.

¶ Contingency Fees — the Functional Section for Consulting Engineers requested some time ago that the Ethics Committee give a ruling on contingency fees. The Ethics Committee now has referred the matter back to the Functional Section for an opinion. Contingency fees are not covered in the present Rules of Practice. ▲▲

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double-scrubbing
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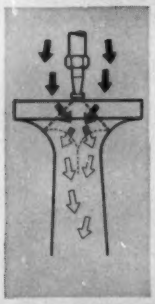
Service-proved in applications around the world, the new Buell W-B Scrubber is now available for sub-micron dust removal jobs in this country. This newest multi-venturi wet collector removes over 99% of dust as small as 0.05 microns. Licensed under the famous Waagner-Biro patents, the new Buell W-B Scrubber offers several distinct benefits over other wet collectors. The most important are discussed below. ■ There are other operating advantages, too, including low water requirements, and case-hardened venturi throat to resist erosion. But why not check into the Buell W-B Scrubber for your own application? For details, write Buell Engineering Co., Inc., Dept. 47-L, 123 William St., New York 38, N. Y.
■ cyclones • electric precipitators • bag collectors • combination systems • classifiers • venturi scrubbers.



**double-scrubbing action** Exclusive! Water is introduced ahead of the venturi, which forms two distinct cones for gas to pass through

**typical process industry uses** sulphuric acid mist–detergent fumes–lime dust–catalyst dust –fly ash–fluorine compound dusts–hydrochloric acid fumes–cement dust–tar–acetic acid fumes –phosphoric acid mist–titanium dioxide dust–salt cake dust.

**low power** This special design achieves the desired efficiencies with low pressure drops; thus, requires minimum power ■ **high efficiency** The Buell W-B Scrubber offers efficiencies for given conditions higher than any similar system.

**any capacity** The new Buell W-B Scrubber is made up of multiple venturi tubes–each a standard, readily-stocked item. Capacity for your application is arranged simply by designing for the proper number of venturi tubes.

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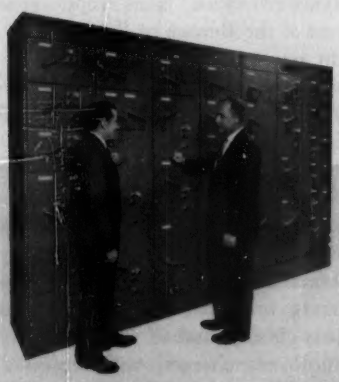
*electricity is distributed and controlled*

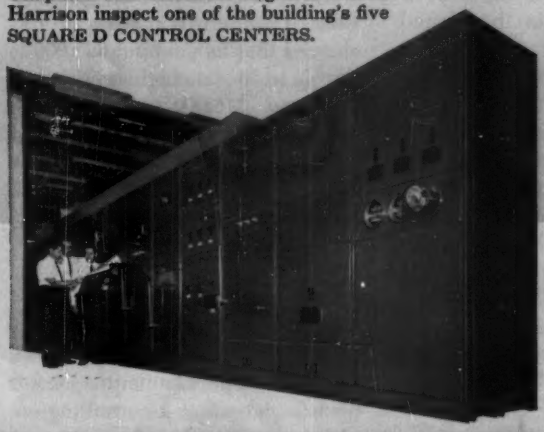
# WORLD'S LARGEST *All-Electric* BUILDING

Atlanta may well be proud of this beautiful structure. Its 23 stories contain nearly a million square feet of floor space—largest commercial building in the South—twice the size of any other office building in Atlanta. One of its most outstanding features—it is heated, as well as air-conditioned, by electricity. Square D electrical distribution and control equipment is on duty throughout this magnificent building.



*Above* • Square D Field Engineer Gene Chapman and Electrical Engineer Morris Harrison inspect one of the building's five SQUARE D CONTROL CENTERS.

There are 140 SQUARE D LIGHTING PANELBOARDS like this one, strategically located throughout the building.



SQUARE D MAIN SWITCHBOARD, 60 feet long, rated 16,000 amperes at 480 volts. Five runs of SQUARE D BUS DUCT (*upper left*) distribute power throughout the building. Checking final installation are Frank Smith and Robert Allison of Brooks-Allison, Electrical Contractor, and Square D Field Engineer Gene Chapman.

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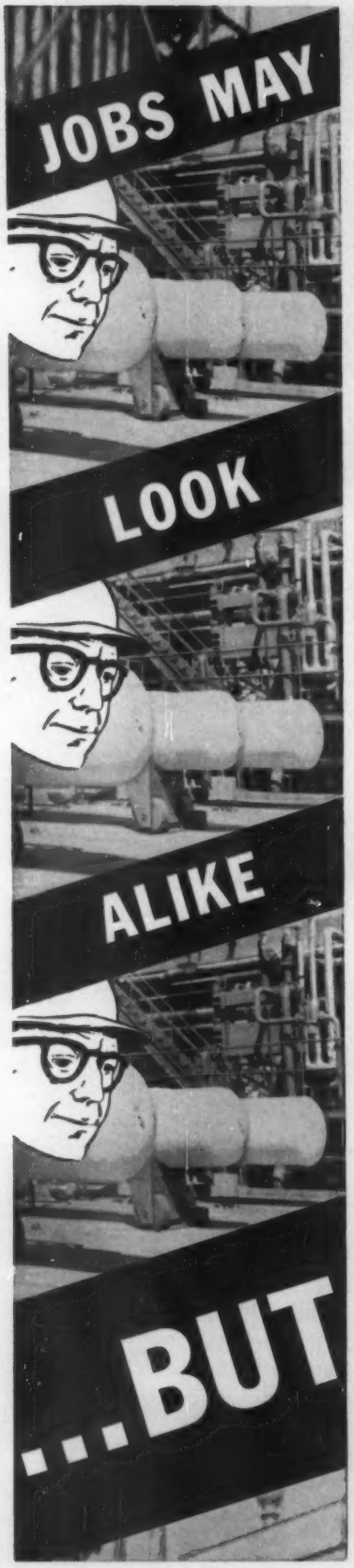



# Sir Gordon Battles Some

SPEAKING at the American Association of State Highway Officials convention recently, Congressman Gordon H. Scherer (R-Ohio) announced that he does not plan to run for re-election. This is unfortunate from the consultant's viewpoint, for Congressman Scherer, a member of the Highway Investigation (Blatnik) Committee, is a strong supporter of private enterprise. He also is one of those rare congressmen — a man who understands the problems of the consulting engineer.

In Denver, he brought up a subject which long has been conspicuous to consulting engineers by its absence. Why is the "short handed" Bureau of Public Roads working in competition with consulting engineers on foreign projects? As Congressman Scherer put it:

"There is one question I would like to pose to the Bureau of Public Roads and the Department of Commerce. To what extent is the Bureau of Public Roads rendering engineering services throughout the world? Why and by what authority is the Bureau doing this? Some people have asked: Doesn't the Bureau of Public Roads have a big enough job with the mammoth road program here in the United States? Others want to know why the Bureau is competing with private engineering consultants in many countries throughout the world. There are some people who have even suggested that the Highway Investigating Committee take a look at the advisability of these practices. Perhaps the Bureau has a satisfactory explanation. I certainly would like to have it because, frankly, I can't answer them."

### The Interstate Program

Congressman Scherer also is concerned about the future of the highway program — afraid that if significant mistakes, derelictions, and frauds in the Interstate Highway Program continue to be discovered, the Federal government might take over administration of the entire road program.

"Let me briefly tell you about just a few of the types of shenanigans that have been taking place in some quarters. I am not going to name states; no useful purpose would be accomplished by so doing.

"In one state . . . highway inspectors and employees on Federal-aid projects prepared false tests; concocted bogus samples of material which was substandard; and concealed information of substandard work from representatives of the Bureau of Public Roads. On one project a contractor was paid for material that was substandard and for other material that was in fact not delivered.

"The Highway Investigating Committee in a second state uncovered a long-standing, pernicious practice wherein highway contractors made weekly cash payments in blank envelopes sent through the mail to state highway employees charged with supervising the contractor's construction work in compliance with specifications. One contractor's books showed that he paid out $23,000 in payola to 26 state highway employees, and $16,000 additional for whisky distributed to them. A state engineer admitted that he had been accepting loans and other cash from a contractor since 1935, amounting to $10,000."

### Consultants In the Act

"In another state, in which only preliminary investigation has been made by our Committee, court records show that a consulting engineer was convicted of income tax evasion for filing fraudulent income tax returns. The engineer

# Dragons

had deducted $275,000 in 'commissions' which he had paid to a bag man, an ex-state official and an influence peddler. This $275,000 was actually 10 percent of the total value of the contracts which the bag man obtained for the consulting engineer's firm. At the trial, the engineer defended himself on the grounds that these commissions were an 'ordinary and necessary cost of doing business in the state.' The evidence seems clear that such illegal payments were necessary if you wanted to do business in this particular state. The defendant engineer testified that some of this largesse was paid to four members of the state legislature and a big bundle of it to a leading politician in the state.

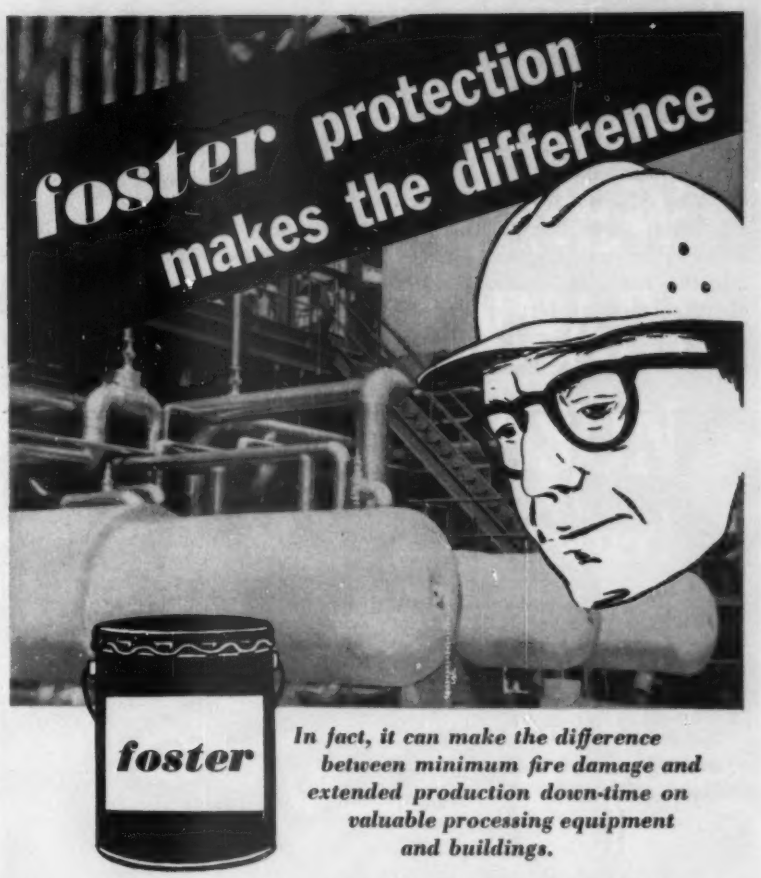
"Now, these practices are not only bad and reprehensible in themselves, but, more than that, they can lead to some basic changes in the building of highways in the future. We all know that the Federal-state partnership over the years has been highly successful from every viewpoint. While it has been a partnership, the states have been senior."

### States' Rights

"Both you and I want to see this partnership continued. I want to see that states remain the senior partners because, among other things, it fits into my philosophy of government, and I believe it does yours. I am opposed to the present vast bureaucracy on the Potomac. I certainly don't want to see it continue to grow and grow.

"What I am trying to say is that some of these sharp practices and misuse of highway funds place in the hands of our opponents the most effective weapon for destroying the Federal-state partnership.

"Just last week, because of the disclosures of irregularities similar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to those I have discussed, my extremely capable colleague in the Public Works Committee, Bill Cramer, who is a states-rights man if there ever was one, felt the need for the enactment of a Federal-aid highway reform act. He introduced legislation accordingly. This act follows Federal highway money into the states and makes the use of it subject to further Federal regulation. It makes the improper use of it subject to Federal criminal prosecution and penalties. You can see the trend.

"I don't want anything I say to be interpreted as a criticism of Rex Whitton, the Highway Administrator. He is an able, competent, dedicated Highway Administrator with the utmost integrity. He is a highway engineer. He is not a politician. He is interested solely in building good roads. In my opinion, his is the best appointment made by the Kennedy administration. I applauded the appointment when it was made, and have had no reason to change my mind since.

"I am deeply concerned, however, about some incompetency and the politics being played in the Department of Commerce with the highway program."

**The Department of Commerce**

". . . First, the people who are making high policy decisions in the Department of Commerce have little or no background of knowledge and experience in highways and apparently have little inclination to acquire any. Second, there seems to be an insurmountable distrust by the New Frontier of career officials who served during the Eisenhower administration, even though they were inherited from prior Democratic administrations. Third, political considerations play a dominant and unusually controlling role in too many of the decisions made and actions taken by the Department of Commerce.

"Politicians in the Department are making decisions and reversing prior decisions in matters which are way over their heads as to all kinds of technical and engineering problems.

"Although I cannot prove it at this time, I am reliably informed that the White House is ready to add some 150 miles to the Interstate system in West Virginia. This 150 miles would come from the small reserve mileage being held back for making vitally needed adjustment in the lengths of approved routes in the various states as projects are advanced to construction. One place where this mileage is not needed is West Virginia.

"Highway people are asking: 'Why are they giving practically all of this mileage to West Virginia when there is no real need for it, compared to the critical needs of other states?' Some people are nasty enough to say that it is being allocated out of gratitude for the results in a certain West Virginia primary." ▲▲

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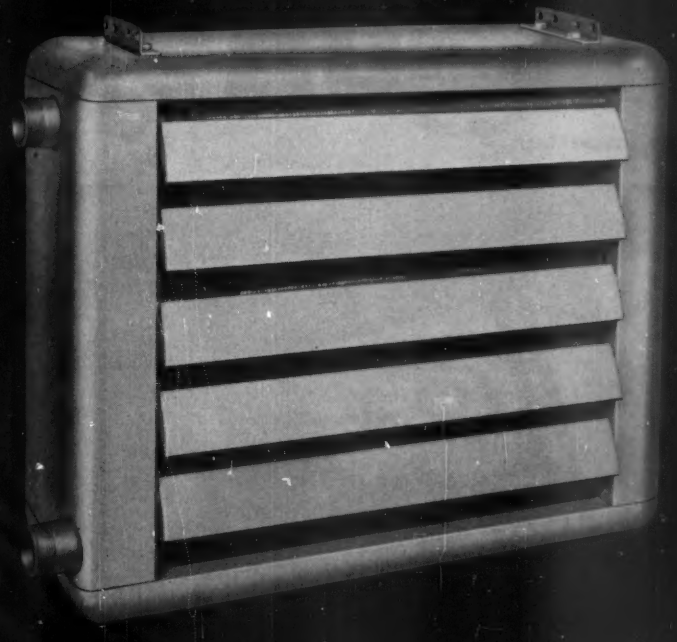

1 New High-Efficiency 2-Way Coil—Steam or Hot Water

2 Supply-Return Tappings On One Side of Unit

3 New Compact Cabinet Design Provides More Headroom

This is the new Kennard/Nelson Unit Heater. Its unique double-duty coil combines the optimum heat transfer requirements for *both* steam and hot water systems. The new Kennard/Nelson coil design permits the highest possible capacities and widest ranges available with *either* heating medium.

The unit is specially designed for easy installation. Supply and return tappings are conveniently located on the same side of the unit. This arrangement cuts piping and labor costs, makes snug ceiling and wall mountings possible, and gives a pleasing, uncluttered appearance. Compact cabinet design also provides more headroom.

Clip and return the coupon for complete information on the new Kennard/Nelson Unit Heater with its double-duty coil. Mail to: Engineered Air Systems Division, American Air Filter Company, Inc., 300 Central Ave., Louisville 8, Ky.

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*Mail this coupon TODAY!*

Please send me complete information on the new Kennard/Nelson Unit Heater.

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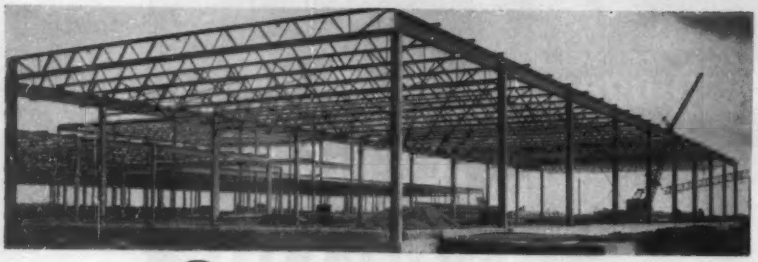

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This mark tells you a product is made of modern, dependable Steel.

# $2500 ...by using USS A36 Steel

**"We submitted two bids for fabricating the long span steel joists for the new Mallory Controls Company (a Division of P. R. Mallory & Co., Inc.) plant to be built in Frankfort, Indiana," said Mr. Sidney L. Berger, president of The Berger Steel Company, Inc. "One was for A7 steel, the other for A36 steel. The higher strength of A36 steel cut the total tonnage by approximately 18 tons. This not only lowered our bid, but it also lowered shipping and handling costs. We figured the total material savings with A36 steel to be approximately $2500."**

Mallory Controls Company, the architects, the contractor, and the fabricator were quick to see the weight- and money-saving advantages of A36 steel. Unfortunately, A36 was not available by specification in time to be incorporated in all sections of this structure. The contracts for the new plant were let in November, 1960 . . . only one month after the introduction of A36 steel. Had A36 been available for beams and columns, *as it now is,* additional savings could have been passed directly on to the owner. There are 200 tons of A36 steel in the top and bottom chords of the joists, fabricated in 60, 50, and 25-foot lengths. Long span joists were used to provide wide bays for continuous line production. When completed, there will be 130,000 square feet of floor space for manufacturing and 20,000 square feet for offices and cafeteria.

Investigate the advantages of designing with A36 structural steel. Its higher strength can save you money. Delivery is no problem with the complete range of USS Structural Steels available. Contact your local Steel Service Center, United States Steel's District Sales Offices, or write United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

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USS United States Steel

TRADEMARK

**Owner:** Mallory Controls Company, Frankfort, Indiana **Architect:** L. C. Kingscott & Associates, Kalamazoo, Michigan, Indianapolis, Indiana, and Davenport, Iowa **Contractor:** Arthur A. Gill & Son, Frankfort, Indiana **Steel Fabricators:** The Berger Steel Company, Inc., Lafayette, Indiana (joists), Hugh J. Baker & Company, Indianapolis, Indiana (columns and beams)

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In conventional ion-exchange equipment (demineralizers), water flows downward through a bed of ion-exchange resin until the resin is "exhausted" or loaded with ions. Then, the resin is regenerated by *downward* passage of acid or alkali.

During the service cycle, the ions most difficult to exchange concentrate near the bottom of the bed — sodium in the cation resin and silica in the anion resin. Downflow regeneration means these ions are contacted by partially-spent regenerant, unless large excesses of regenerant chemicals are used. As a result, they are not completely eluted from the bed, and are gradually leached out during the following service run.

In COUNTERFLOW* equipment, service flow is down, but regenerant flow is *upwards*, with a "barrier" to prevent fluidization of the resin. The result — greater regenerant economy, and leakage of unwanted ions reduced by 50% to 75%. COUNTERFLOW* IonXchangers are now providing high quality low-silica boiler feed water in central power stations. The original results observed† in the first large installation in 1956 have been shown to be typical.

(† *Caskey and Harding*, American Power Conference, 1957).

**COUNTERFLOW** *is the trademark of Illinois Water Treatment Company equipment utilizing an up-flow method of regeneration with a "barrier" to keep the bed from expanding. U.S. Patent No. 2,891,007.*

*For detailed information, address:*

ILLINOIS WATER TREATMENT CO.
840 CEDAR ST., ROCKFORD, ILLINOIS
NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
CANADIAN DIST.: Purifiers & Softeners, Ltd., London, Can.

# Our Authors . . .

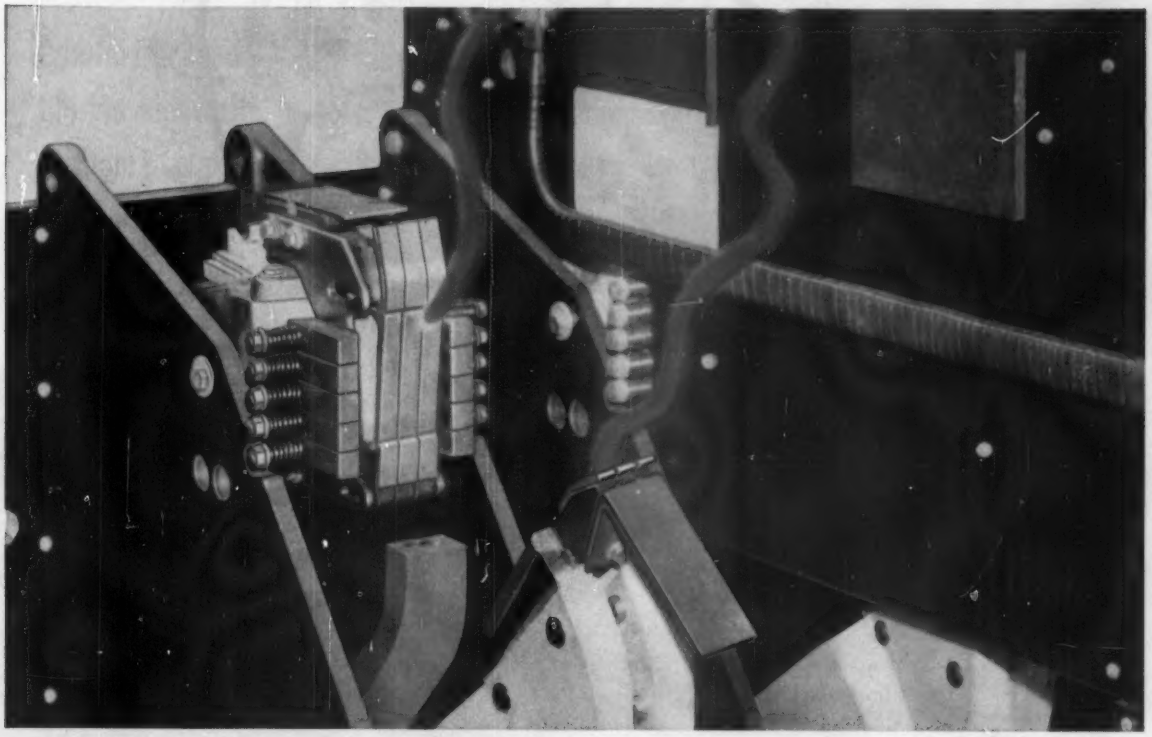
**Peter Englemann,** a native of Germany, received his first degree in civil engineering from Robert College, in Istanbul. Later, he received his M.S. from MIT. He is currently an associate of Parsons, Brinckerhoff, Quade & Douglas, working as a project engineer for port development. He is a member of ASCE and SAME. Englemann's contribution to this month's harbor report is on page 75.

**Victor Santoro** has worked in the field of structural design ever since receiving his B.S. in civil engineering from CCNY, eleven years ago. Three years ago he received an M.S. from the same school, and now is an associate member of Throop & Feiden, supervising structural design for projects in this country and abroad. Santoro's article on the esthetic use of exposed steel begins on page 96.

**Paul Garay** entered the U. S. Navy shortly after receiving a degree in mechanical engineering from Northwestern. During the war, he was an engineering officer on destroyers; following military service, he worked on steam plant design for various West Coast firms. Three years ago he joined Kaiser Engineers. Garay's article on the preparation of technical manuals begins on page 71.

**Harold Franzblau** has been a mechanical engineer for the past 25 years, and presently is a partner in the firm of Visco, Franzblau Associates. During World War II, he worked for the U. S. Navy, trouble-shooting at war plants. In addition to engineering articles, Franzblau writes scripts for television and movies. His article on the failure of the public to appreciate engineers is on page 103.

# ALLIS-CHALMERS



# Full protection at 1 million kva

## with this 15-kv maximum reliability metal-clad switchgear

**New interrupting capability —** 1,000,000 kva and below with *Ruptair* magnetic air circuit breaker in A-C 15-kv switchgear, means complete system and personnel safety.

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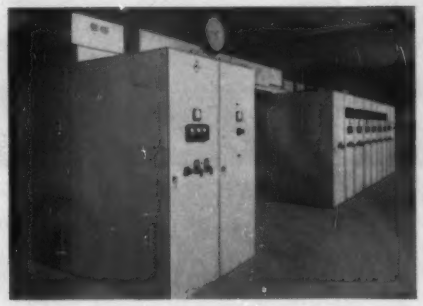
Tilted front steel barrier locks with cubicle to protect operator.



15-kv indoor metal-clad switchgear installed in a western utility.

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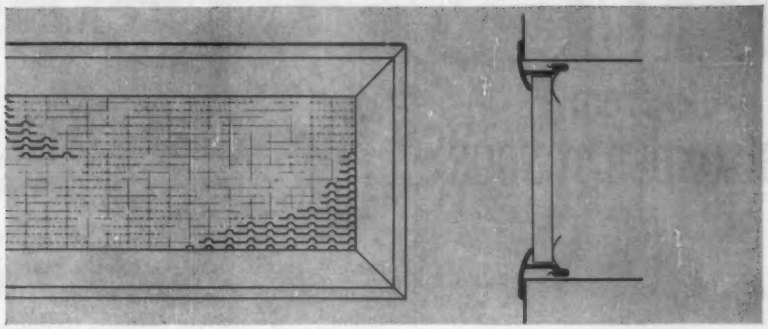
**Comfort-proven Uni-Flo sidewall diffusers available in a wide variety of extruded aluminum frames**



Now you can combine the air distribution superiority of the Uni-Flo sidewall diffuser with any one of a wide variety of attractive aluminum frame styles—to make air behave *beautifully* in more ways than one. Each extrusion opens a new realm of design opportunities to the architect—yet each possesses the architectural grace to blend inconspicuously into the room decor.

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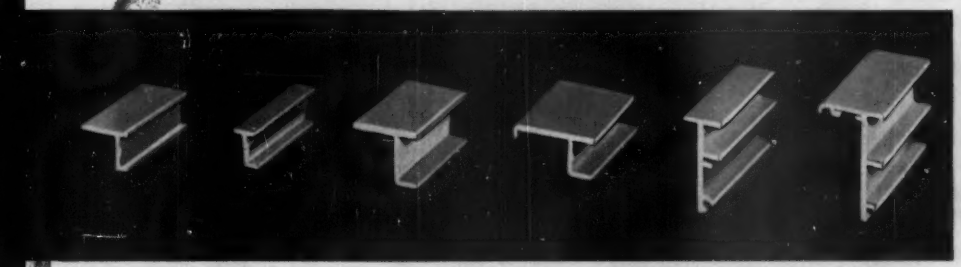

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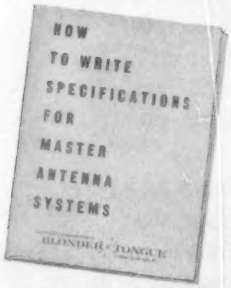


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# The Readers' Guide

"The complex integration of numerous engineering and technical systems must be explained to diverse groups of interested personnel . . . A properly planned technical manual will do this, and yet will be economical of the manpower required to prepare it." Paul Garay explains the preparation of technical manuals, which are becoming more numerous and more involved as our technology becomes more complex.

**Docks and Harbors**

*page 71*

"Until the 20th century, shipping was a leisurely business, with vessels often staying in port a week or more to unload and load cargo and passengers. But the construction of larger and faster vessels, the rapidly rising cost of ship operation, and the quickening tempo of business brought about a new concept in harbor design." In a special staff report, including an article by Peter Englemann on planning, CONSULTING ENGINEER reports and analyzes the changes and trends in ship-handling facilities in the major ports of the world. The salient observation from this study: ports no longer just happen, they have to be planned.

**Technical Manuals**

*page 68*

". . . the professional engineer must share his pedestal with Casey Jones, the crane operator, the refrigerator attendant, the boiler stoker, the discharged soldier from the U. S. Corps of Engineers, and a wide variety of commercial allies." Harold Franzblau makes a plea for distinctions between the registered professional engineer and his ubiquitous namesake.

**What is an Engineer?**

*page 103*

"Today, many buildings present convincing evidence that skillful treatment of exposed beams and columns can produce a striking effect, one that can be duplicated by no other method." Victor Santoro points out the possibilities for esthetic improvement in our buildings through exposing, rather than hiding, the structural steel elements.

**Esthetics of Steel**

*page 96*

YARWAY news briefs

*from* **Yarnall-Waring Company,** *Philadelphia 18, Pa.*

*BRANCH OFFICES IN 19 UNITED STATES CITIES • SALES REPRESENTATIVES THROUGHOUT THE WORLD*

# YARWAY GUN-PAKT EXPANSION JOINTS ARE BEING SPECIFIED IN RECORD NUMBERS

## These user-benefits tell why:

All over the country a rapidly-increasing number of expansion joint jobs on steam and high temperature water piping at utilities, industrial plants and institutions are being specified "YARWAY GUN-PAKT." Here's why:

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Shutdowns are eliminated. Packing can be added *under full line pressure.* No vents. Joints never need repacking.

**SIMPLIFIED DESIGN**

Sectioned view (below) shows at a glance the simple, compact design. Provides easy accessibility, takes less space to install and maintain, needs smaller manholes, fewer joints per length of pipeline.

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All-steel construction, with durable, chromium-plated seamless steel sleeves. *No chance of metal fatigue.*

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Positive alignment of sleeve in stuffing box, *where it counts.*

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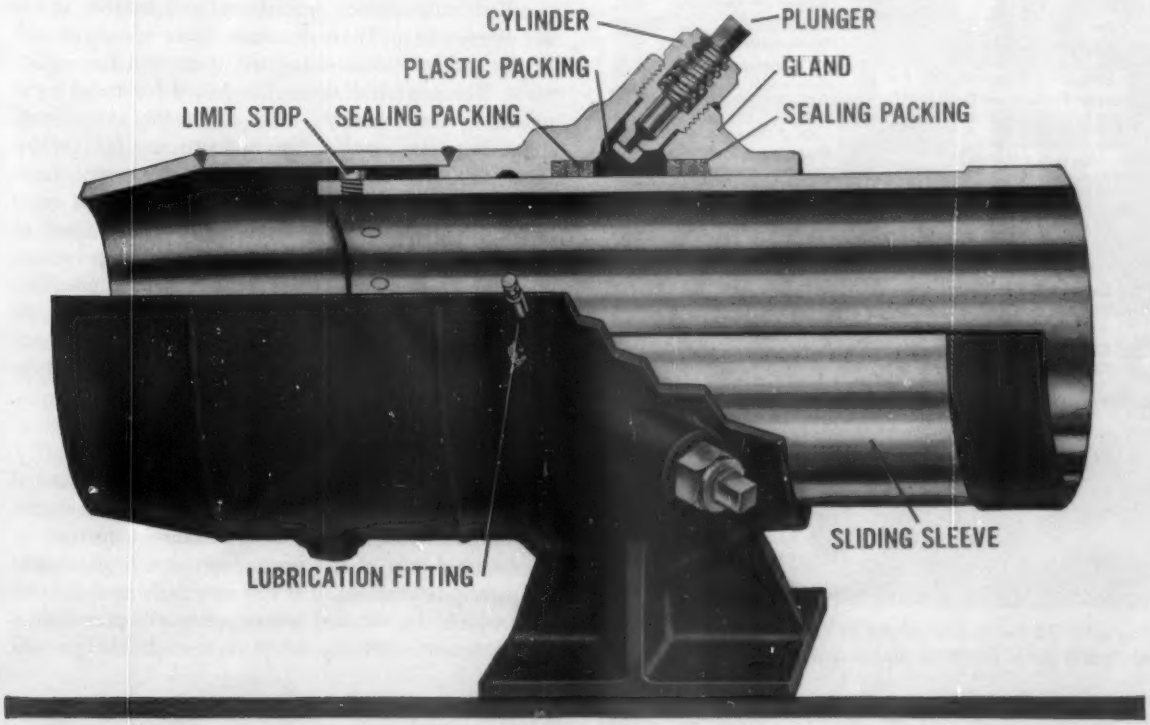
Why don't *you* investigate Yarway Gun-Pakt Joints by calling a Yarway Sales Engineer at one of the 20 Yarway offices located from coast-to-coast—or simply by writing for Bulletin EJ-1917.



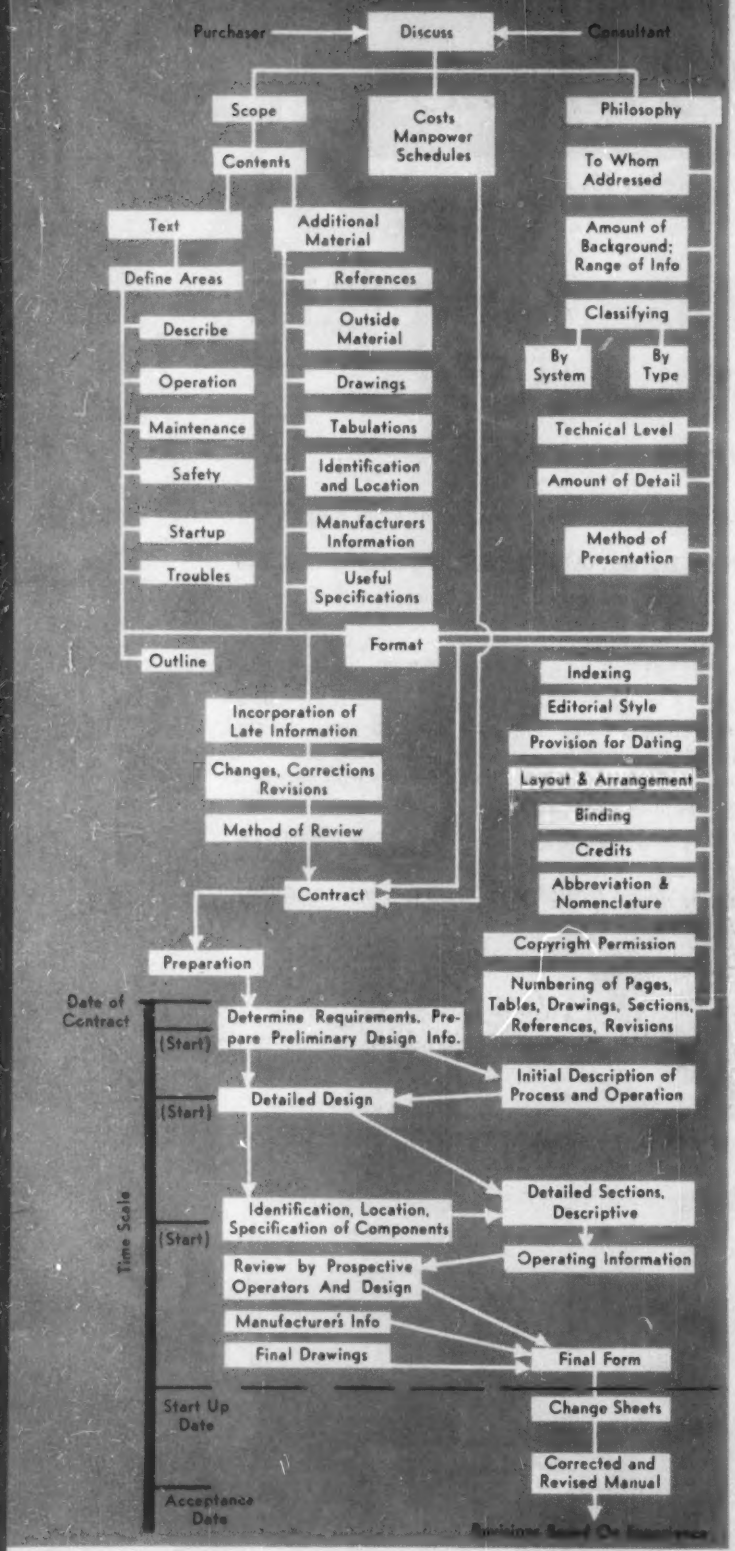



*Fig. 1 — The structure of the technical manual, showing necessary prior decisions and actual steps of preparation.*

# The Technical

THE SCOPE OF WORK encountered by consulting engineers is far wider today than it was 10 years ago. Where once a chemical process plant was the most original and advanced concept with which he had to deal, it is now commonplace to work with missiles, missile launching facilities, nuclear power plants, radioactive processes, newly developed power conversion systems, highly automated machinery plants, and space systems. All these recent developments are being handled by consulting firms as routine matters.

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The firm that handles the project makes technical studies, and bases its final designs on these studies and on the personal and unpublicized efforts of the technical staff. The transmission of this technical knowledge and accumulated data is not limited to simple reference to the blueprints. These may be suitable for construction of the new facility, but the essential philosophies upon which the design is based must be imparted by means of the technical manual.

Engineers who were in service in wartime will remember the elaborate technical publications issued by the armed forces, replete with exploded views, detailed maintenance procedures, and trouble shooting suggestions. These manuals were ideally suited to the task of familiarizing the user with his equipment. The technical manual required for today's engineering developments must fulfill the same functions, but its scope and complexity are far greater than we have hitherto regarded as necessary for a manual. The complex integration of numerous engineering and technical systems must be explained to diverse groups of interested personnel — supervisors, operators, mechanics, policy makers, and administrators. A properly planned technical manual will do this without making unreasonable demands for manpower. It will be adequate, simple, and useful both to the consultant and to the purchaser.

### Manual Preparation Procedure

It is unfortunately true that the average technical manual falls short of its ideal functions. This occurs when the manual is just an afterthought, instead of an essential part of the over-all project. A point that frequently is overlooked is the extremely useful function which the manual serves when its preparation is concurrent with the design: errors in design will

# Manual

PAUL N. GARAY, Kaiser Engineers

be discovered; bugs ironed out; omissions revealed; and inconsistencies rectified or resolved prior to firm design commitments.

The preparation of the properly planned technical manual will proceed smoothly, on schedule, with a minimum of confusion, toward a well defined objective. The planning should start early, preferably toward the beginning of the project. Fig. 1 illustrates, in block form, the particular area of prior decision, comprising generally:

*Scope* — This defines the expected functions of the technical manual, and maps the areas of discussion and planning to be considered. It encompasses all questions related to the extent of the effort which will be expended: How detailed will the material be? Will it include description, operation, initial startup, maintenance, testing? How detailed must the procedural description be? Will it suffice simply to state "start system A," or will a step-by-step starting sequence be required? Will all the components and elements of the system be individually numbered, grouped in systems, or in what manner will reference be made to them? Will groupings, where used, be made according to function, or according to similarity of equipment? Will manufacturers' handbooks be incorporated, or simply referred to by calling attention to the information contained therein? What drawings and pictures will be used?

The size, shape, and style — the format of the final publication — should be decided. This includes page numbering, indexing, credits, titles, and all the decisions that will be required of the technical editor. It also includes the usual legal disclaimer of responsibility for the contents.

*Philosophy* — This describes the less formalized effort that will be incorporated in the total work. The philosophy defines the limitations of the text, as well as providing direction for the flow of technical output. Several questions naturally fall into this category:

¶ To whom will the main part of the text be addressed — management or operations personnel, college graduates or technicians?

¶ Why incorporate abstract discussion and design philosophy? Is the subject so unusual that background information is necessary? For example, in an information manual devoted to a relatively conventional steam plant, discussion of design philosophy and generalizations about the nature of steam processes are wasted, since neither the operators nor the supervisors of such a plant will be concerned with abstract factors. On the other hand, the operators and users of an experimental nuclear reactor not only may be interested in such information, but may be gravely concerned, since the nature of their operations is restricted by the safety factors and limitations incorporated in the original designs and calculations.

¶ Will the material be described according to systems, or will the over-all project be described as a functional entity? Here, the answer depends upon whether the project will function essentially as a single process or as a composite of multiple systems, which, while coordinated, may be considered as isolated (even though the operation of the groups is necessary for proper functioning of the whole). For example, in material covering a chemical process it would be difficult, if not impossible, to define boundaries for systems. Conversely, for a steam power plant the various contributory systems may be defined readily. It may be desirable, in this instance, to prepare a section of text in which the integrated operation of the various systems is discussed.

¶ As a corollary to the preceding question, what relationships should be established among functional description, operating information, control system philosophy, electrical equipment functions, and overall operating information? It will be found upon examination that the answers depend not entirely upon abstract considerations, but partly upon the rational definition and recognition, of these various areas. What is a control system, as distinguished from an electrical system which contains breakers, relays, and other automatic components? Where does a functional description coincide with or overlap an operating instruction? The answer to this question, then, is a matter of defining each area and adhering to these definitions when preparing the material.

In this category may be considered the method by which functional description will be limited, and separated from operating information. At first glance, it would seem logical to include operating information for a particular system along with the description of the system. However, in complex systems, this method can lead to confusion, because of the sheer bulk of the material through which the reader must wade in order to find the desired information. The ideal method of presentation would seem to be the happy medium, with description and operating information for small systems presented together, and with these two types of information presented separately for more complex systems. To prepare the information with a minimum of overlap, a general policy should be established on each project, and the method of presentation determined beforehand.

¶ How will the material be categorized? Will the pres-

entation be made on the basis of grouping all similar equipment under one heading, or will a systems grouping be used? Although groupings by equipment type simplify reference to a particular piece of equipment, in most instances the best method of classification is by systems. Inasmuch as complex projects are functional, the text should be classified similarily. A grouping by equipment type may be feasible for an experimental or pilot project, in which groups of equipment – such as pumps or coolers – may be used for different system functions. This will depend largely on the connecting circuits, which may be changed from time to time.

*Contents* – Regardless of the philosophy or the scope of the effort, the information should be complete for the sections which are included. The reader should not be required to refer to external information. If the contents are properly organized, all the necessary information will be available within a particular section. Useful sections of the manual should include:

¶ Valve and pipeline numbers, showing locations, use, and description of all valves. It should not be necessary to search the prints for this information.

¶ For complex projects, a grid system should be superimposed on all drawings. This will assure easy location of all elements of the project. A directional arrow and an elevation designation should be part of the location indication for each element.

¶ References, drawings, codes, manufacturers information, and illustrations.

¶ Tabulations of instruments and controls, showing number, location, mode of operation, set points, range of adjustments, and informational references.

¶ Tabulations of electrical equipment, describing equipment, as well as showing location, type of power, power requirements, and control circuits.

¶ Functional descriptions of systems and equipment. These descriptions should include the tabulations described in the preceding paragraphs.

¶ Operating information, including prerequisites of start-up, operation, and shutdown of all equipment. Maintenance operations and instructions may or may not be covered in the manual.

¶ Safety precautions and trouble shooting.

¶ Performance charts and curves for systems and equipment.

¶ Tabulation of purchase orders, vendors' names, tional parameters.

¶ Index and table of contents.

¶ Tabulation of purchase orders, vendors names, equipment identification, and similar information. This may be of particular value in correspondence.

¶ Manufacturers information, including operating and maintenance information, as well as spare parts lists. This last category of information may be in a reference section external to the manual, but it should be readily available.

*Schedules* – The schedule of preparation should be devised to consider the following points:

¶ The consultant's staff, as well as the purchaser, should benefit from the information.

¶ The manpower required for other phases of the project should be allocated so that properly qualified personnel are available for the preparation of the manual.

¶ Sufficient time should be allotted so that the manual is essentially complete, or at least useful, in time for the purchaser's staff to study it prior to completion of the project.

¶ The schedule should be coordinated with the design effort so that a minimum of rework, due to normal design changes, is necessary.

Ordinarily, the manufacturers' information will not be available until the latter phases of the project. The manual should be so organized that these last-minute data may be fitted into the text without extensive rewriting or disruption of the previous work.

### Cost and Value

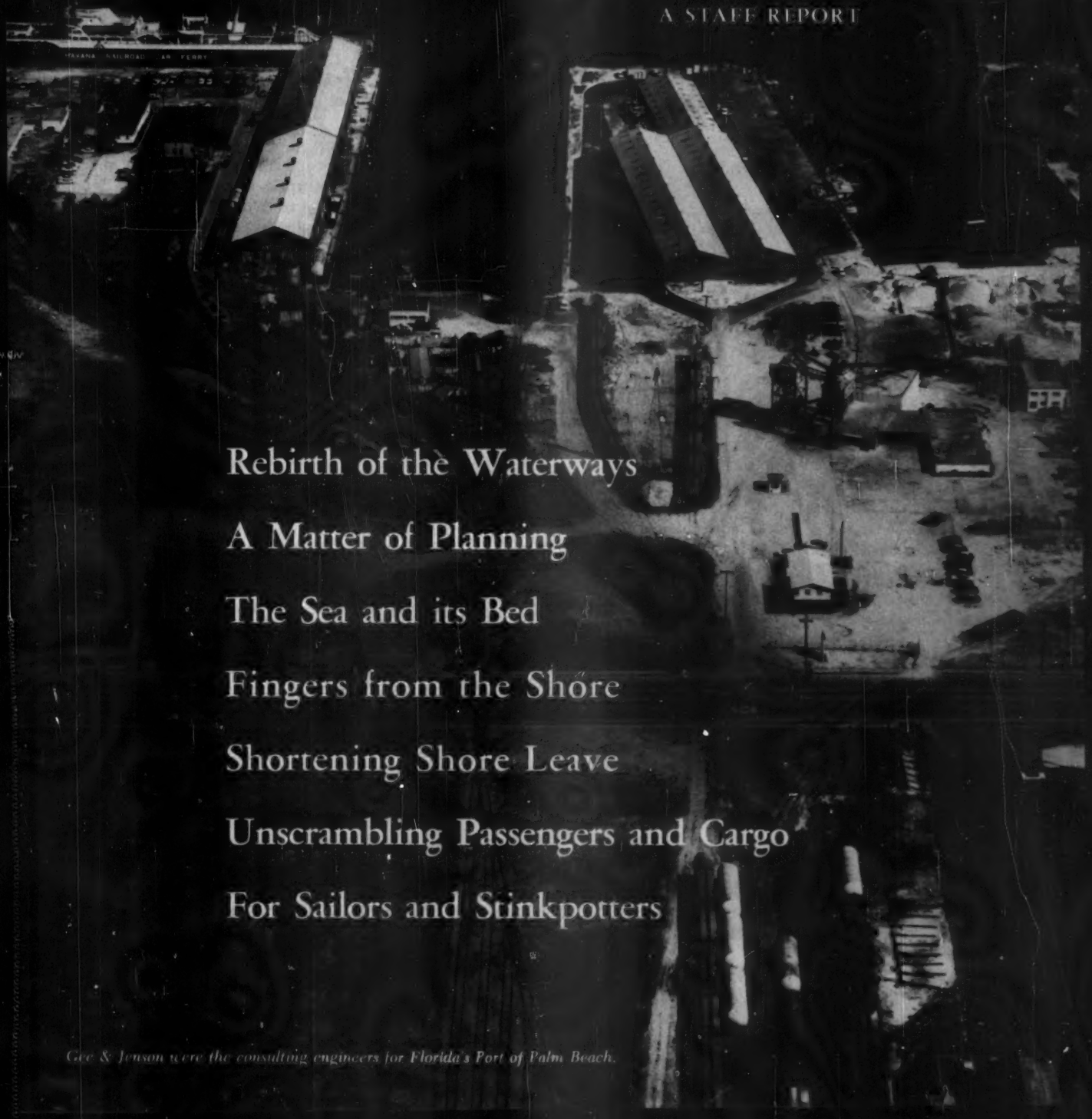
The consultant must charge for the technical manual on the basis of adequate time for preparation. However, if preparation and design effort are concurrent, the preparation costs are reduced considerably. Some of the work and effort which are applied to the early stages of the manual can be utilized by the design groups in several ways – for instance, in lieu of the process descriptions which are required prior to the design of a process system. Of course, this points up the desirability of assigning to the manual personnel who are qualified for preparing the process descriptions. In turn, the design group can aid the writing group by providing, as the design progresses, adequate identification, location, and descriptive details for all the components when these are fitted into the over-all project. Treated on this basis, the cost of preparing an adequate technical manual is roughly one half of the cost of a similar manual, prepared independently and as a later-stage effort.

The discussions of the manual, having settled the necessary factors which might tend to confuse the details of the manual preparation, should next be concerned with a preliminary outline to indicate the decisions that have been made. The outline, in preliminary form, ultimately will be found to be inconsistent and full of holes when compared to the textual requirements; it should, therefore, be used as a general guide, rather than a bible. However, once established, the outline should be followed.

When the manual has been discussed, shaped, and outlined, the final agreements should be concerned with schedules, manpower requirements, and the mechanics of production, review, routing for approval, and the incorporation of corrections and changes. ▲▲

# Docks and Harbors

A STAFF REPORT



Rebirth of the Waterways

A Matter of Planning

The Sea and its Bed

Fingers from the Shore

Shortening Shore Leave

Unscrambling Passengers and Cargo

For Sailors and Stinkpotters

*Gee & Jenson were the consulting engineers for Florida's Port of Palm Beach.*

## Docks and Harbors

# Rebirth of the Waterways

SINCE THE DARING mariners of Phoenicia, Greece, and Rome ventured into the then unknown sea lanes as far as Britain to the north and West Africa to the south, adequate harbor and port facilities have been recognized as essential to the economic growth of nations. Some of the earliest examples of engineering skill are to be found in the breakwaters, wharves, and piers of the nations that have led the world in commerce and industry. In fact, the port city of Alexandria still is a challenge to the port engineer of today.

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Until the 20th century, shipping was a leisurely business, with vessels often staying in port a week or more to unload and load cargo and passengers. But the constructon of larger and faster vessels, the rapidly rising cost of ship operation, and the quickening tempo of business brought about a new concept in port design. Today's large ships frequently are in the harbor less than 24 hours. This rapid turn-around time requires the most modern cranes and belt conveyors for dry cargo, pumping systems for liquids, and pneumatic systems for granular materials. Other cargo is handled by fork lift trucks, mobile cranes, and battery and engine-powered truck and train units, which move rapidly about in transit sheds and warehouses.

Trucks are handling an increasing volume of freight to and from ports. In the United States, West Coast ports are served more extensively by trucks than the East and Gulf Coast ports. Containerization allows the movement of cargo in specially designed containers from point of origin to destination in a distant land without rehandling except by special crane at dockside and destination port.

All of these changes, and others to come, have profoundly influenced the design of harbors and port facilities. The old narrow finger piers and wharves have given way to wider piers and wharf aprons for rapidly manuevering trucks and cranes, and to transit sheds easily accessible to lift trucks and mobile cranes. The almost complete change from coal to oil fueled ships has made bunkering facilities mandatory, so that ships can take on fuel while loading and discharging cargo.

### St. Lawrence Seaway Developments

Another major development in the shipping industry has been the emerging importance of our inland ports. With the opening of the St. Lawrence Seaway in 1959, ocean-going vessels were able for the first time to reach all of the major Great Lakes ports. The present Seaway system is capable of handling a 730-ft ship, with 72-ft beam and 27-ft draft, and a capacity of 26,000 tons. However, the maximum draft cannot be utilized at this time due to the limitations imposed by connecting channels. The deepening of these channels will be completed in 1962.

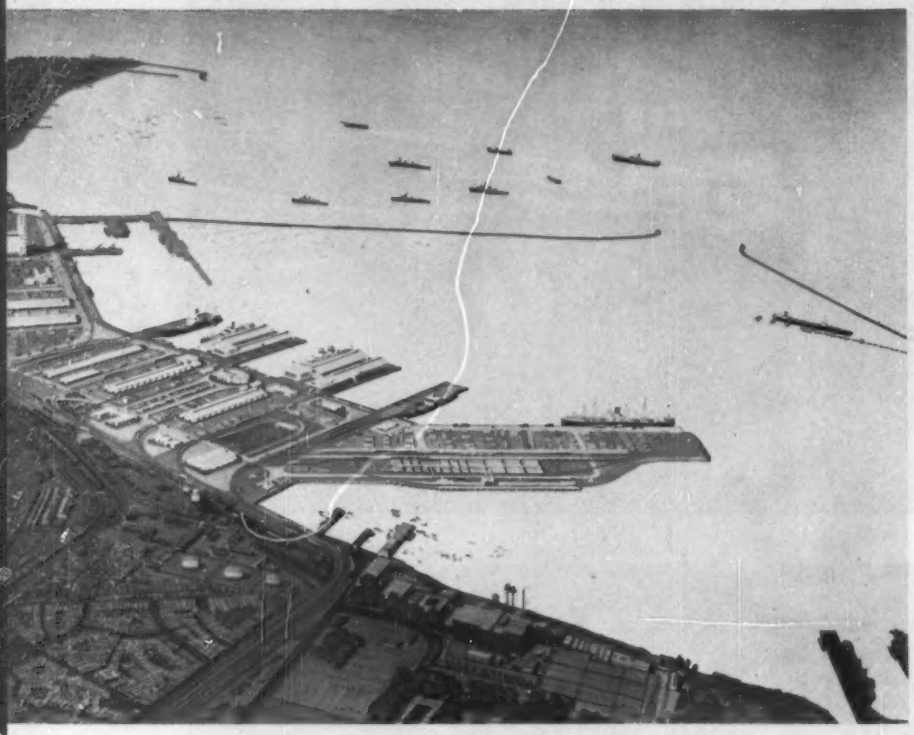
To prepare for Chicago's future harbor development, the engineering firm of Tippetts-Abbett-McCarthy-Stratton submitted a 15-year port development program with an estimated price of $37 million. Improvements completed in 1959 included widening of the south side of Navy Pier, and the construction of a concrete dock, 96-ft wide and 1095-ft long, supported on 970 steel pipe piles. The transit shed was rehabilitated by capping all piles under the shed and filling the voids with grout to increase the floor load limit from 250 to 600 lbs per sq ft.

In addition to Navy Pier, Chicago has three other general cargo terminals: the Chicago Regional Port District at Lake Calumet; the South Water Street Terminal at the mouth of the Chicago River; and the International Steamship terminals at 95th Street and the Calumet River. The Chicago Regional Port District has a $45 million expansion program for Lake Calumet Harbor, to include new dock and storage facilities.

*Over-all aerial view of the Port of San Francisco, showing the most important of the docking facilities.*

*The municipal passenger and auto pier in Milwaukee, built to keep pace with St. Lawrence Seaway.*

*A $37 million expansion program for Chicago area, designed by Tippetts-Abbett-McCarthy-Stratton.*



# Docks

# A Matter

*The major port development program for the Port of Callao, Peru, S. A., planned by Parsons, Brinckerhoff, Quade & Douglas.*

SOME PROJECTS may take years to develop, while others, because of their urgency, lead quickly to design contracts. Port studies and master plans prepared by an engineering firm may be carried out in the design stage by the port authority's own engineering staff, or other engineering firms may be given design contracts. If the port study and design work is complex and involves overseas projects, joint ventures may be set up.

### Typical Examples

Daniel, Mann, Johnson & Mendenhall, Los Angeles, has been very active in this work, having recently completed a feasibility study for the Government of Indonesia, covering 12 ports spread throughout the Indonesian archipelago. The project involved an investigation of existing port facilities and maritime commerce; collection of data on tides, currents, and geological conditions; and the development of concepts for new construction and improvements. Now in the design stage, the various projects will be financed jointly by the Government of Indonesia and the U. S. Development Loan Fund. Major features include hydrographic surveys; design of piers, wharves, cargo handling facilities, loading docks, transit sheds, and warehouses; and water supply, treatment, transmission, and storage.

Holmes & Narver, Inc., Los Angeles, has performed port studies and design work for the Atomic Energy Commission. Most of the work was done between 1949 and 1958 at Eniwetok and Bikini Atolls in the Pacific — headquarters for nuclear bomb testing. New facilities included deep water piers, petroleum unloading and storage structures and equipment, and barge slips at both islands.

Though the Port of Sacramento is not yet an operating port, construction of a ship channel and related facilities by the U. S. Army Corps of Engineers will be completed in June 1963. Terminal facilities also will be completed by this date. A new Sacramento River deep-water channel will permit ocean-going ships and barges to move from Suisun Bay to the city, a distance of 42 miles. Barge canal locks — the first navigation locks to be built in California — will be built to provide sufficient water depth. The entire project will cost $28 million.

George F. Nicholson, Long Beach, was the consulting engineer for this project in its early stages. Following his death, the work has been continued by his associate, A. F. Benscheidt. The Sacramento-Yolo Port District has employed other consulting engineers in the design of a new grain elevator, railroad facilities, power lines, and other facilities. A port district engineering department with a limited staff also is maintained.

A joint venture, Law & Wilson-Tudor Engineering Company, Honolulu and San Francisco, prepared a

# ınd Harbors

# of Planning

two-part port study for the Board of Harbor Commissioners of Hawaii. The first phase, dealing specifically with a plan for developing and financing a new $7 million overseas passenger and freight terminal, recommended a two-level passenger and cargo terminal. Arriving and departing passengers will use an upper deck, which includes access ramps and large deck parking area for automobiles, buses, and cabs. This completely separates cargo and passenger areas. Phase II of the report is a complete economic survey of the islands, with studies of all piers, channels, and bridges and plans for their development.

Tudor Engineering Company, San Francisco, made a similar report of port facilities for the government of Peru. The study covered economic and geographical conditions, port organization, facilities, and cargo handling for all the nation's 11 principal ports, except for Callao, which is under a separate port authority. Specific recommendations were made for modernization and new construction, with suggested designs for piers and transit sheds. The report recommended use of local material for port works to reduce costs, and suggested concrete rather than steel, with the use of precast or prestressed rather than cast-in-place members. Prestressed concrete piling was recommended, with the exception that concrete caissons may be preferable in areas where deep water is encountered over a hard bottom.

*. . . port planning is a matter of vision, understanding, and purpose.*

PETER ENGLEMANN
Parsons, Brinckerhoff, Quade & Douglas

PORT PLANNING involves study and analysis in three separate areas: transportation economics, terminal operations, and terminal planning and construction.

Studies of transportation economics, to determine the type and volume of future traffic, include forecasts of industrial, agricultural, and population growth in a port's tributary hinterland; evaluation of trends in demand for major commodities included in the potential traffic; and comparison of rates on alternate routes. As a component of transportation systems serving international commerce, ports are affected by economic and political events far beyond their own sphere of influence. The determination of "anticipated needs" will, therefore, include estimates that share the uncertainties of all general forecasting.

Studies on terminal operations to accommodate anticipated traffic are concerned with carrier characteristics, regional distribution methods, cargo handling equipment, and practices of the terminal users; storage requirements; and related commercial port activities. These considerations inevitably will lead to questions of terminal location, layout, or design, and hence into the third area of study: terminal construction.

Planning and design for port terminal construction include the most varied and interesting aspects of civil engineering, ranging from subsurface problems to surface traffic analysis, from heavy waterfront construction methods to light building design, and from harbor hydraulics to hydraulic equipment mechanisms. However, in over-all port planning, terminal construction is based principally on the following relationships to the other two areas of study:

¶ The size, layout, and design of port facilities largely control the efficiency of terminal operations and affect cargo handling cost.

¶ Initial construction cost and maintenance cost of terminals usually govern rentals and

other charges on terminal users (which are passed on to the shippers as a part of handling cost).

¶ Total port commerce can become a function of terminals, to the extent that terminal capacity — or lack of it — may limit traffic movements through the port; and quality and cost of terminal services may attract or repel traffic.

### Sequence of Development

The interdependence of these three areas of study often makes it impossible to proceed with port planning in a completely logical sequence. However, the terminal's market is the planners principal guide to port development. This market, as revealed by the interest of potential tenants of terminals, frequently will give a fair indication of the economic merits of proposed terminal construction.

Planning for construction also is concerned with "the disposition of assets" within a port. Natural or man-made physical features of the available sites offer opportunities for port development and, at the same time, constitute its ultimate limitations. For the long view, planners must take considerable care to conserve a port's resources.

There is a fourth area of consideration in port planning: the general environment of terminals, together with the traffic — unrelated to ports — on arterial links serving the regional and inland distribution of cargo. Today, most city and regional planners face monumental problems of population explosions, urban renewal, suburban and industrial sprawl, traffic congestion, deficit-ridden mass transit, airport relocation, vanishing recreation space, shrinking budgets, and limited authority. It should come as no surprise then, if the added burdens created by a complex port activity appear excessive. Nevertheless, only the solution of port problems as an integral part of the environment can prevent the ultimate strangulation of basic functions in large metropolitan areas. The close coordination of port planning with all other industrial, city, and regional planning is imperative.

### The Limitations of Planning

Turning to the environment of planning and of planners, we frequently find that the practical and psychological conditions are frustrating. There is always a temptation to build for only the immediate proven needs, and to postpone long-range planning until factual data based on experience are available.

Historically, many large ports have become successful without plans. Much cargo has been handled under the most adverse conditions, and developments in waterborne commerce often have run contrary to all expectations. Nobody can estimate the cost or losses these situations have caused. Many of the ports have survived, and so has most of the cargo.

This background does not offer much encouragement to planning, nor do some of the prospects for the future. In addition to the indefinite variables in anticipating volume and type of commerce, we must concede that we cannot predict with certainty the handling characteristics of future cargo, possible technological developments in terminal operations, sizes of future vessels and inland carriers, or practices or standards that may result indirectly from competitive situations in the trade.

These limitations sometimes are cited in support of a negative view on planning. In fact, it must be acknowledged that sound planning alone cannot:

¶ Prevent mismanagement of adequately-planned and built terminal facilities.

¶ Economically satisfy all the demands created by extreme peak traffic.

¶ Insure equal future benefits to all existing port-related interests.

¶ Create traffic where there is no commerce.

¶ Provide for the unforeseeable.

¶ Guarantee the perpetual popularity of planners.

### Timing and Approach

Port planning is rather like an educational process in many respects, and it should be approached in a similar manner. It should be continuous, cooperative effort aimed at furnishing the prerequisites for future growth and development — without, however, offering firm guarantees of success.

To stress the importance of port planning as a continuous process may give rise to the suspicion that the intent is to provide merely for the continuous employment of consultants. But in practice, the responsibility for continuity, for year-to-year review of plans and developments, for liaison with related city and regional agencies, and for maintenance of a lively public interest in port development and growth rests solely with the local port agency and cannot be delegated. At intervals, a planning consultant may contribute a fresh approach in the review of plans, but his primary function will remain the preparatory work for major construction projects — commencing, of course, well in advance of the time of actual construction of the project.

Even in planning and design work for port construction, the role of the consultant must be joined with that of the port agency and the prospective terminal users in one cooperative effort. The general climate in which such work is conducted and the selection of persons assigned to work as members of a planning team are of equal importance to the ultimate success of any port project.

Since specific terminal facilities can be provided only for known and immediate needs, provisions for anticipated, long-range developments are made by

general space allocations. These must be for the terminals proper, for all required access to them, and for associated auxiliary port facilities. In most major metropolitan areas, these space allocations will be in conflict with other important needs (industrial, residential, or recreational). The "climate" for planning, together with the qualifications of those involved, will play the most significant part in resolving such conflicts among varying factors.

## Trends

The effectiveness of planning depends largely on accurate analysis of general trends in the transportation industry and correctly interpreting their effect on local conditions. As with other industries, ports are affected by today's accelerating rate of change in technological development, and some of the most significant trends warrant brief mention:

*Passenger movements* on transoceanic routes to date included all types of travelers, with a preponderance of tourists desiring economy accommodations. It now seems certain on most routes that the economy traveler soon will take entirely to the air, leaving ships to the more leisurely and demanding passenger. This will have a bearing on the selection of sites and on the type of construction for future passenger-ship terminals. Comfort and convenience, both with a capital "C," will constitute the commercial justification for these passenger traffic facilities.

*Bulk cargo movements*, of both liquids and dry materials, have resulted in phenomenal increases in vessel sizes, causing difficulties where port channels have insufficient depths. Nevertheless, the economics of major bulk movements seem to warrant the continuing construction of these large vessels. Offshore terminals for petroleum products have overcome the draft difficulties effectively in several locations, and similar facilities for dry bulk transfer presently are being planned. Even for the smaller vessels, available bulk handling equipment now generally permits the removal of storage facilities and of inland carriers from ship-side, resulting in greater flexibility for terminal and port layout.

*General cargo movements* are the predominant influence at most public ports, and are connected with many problems in terminal development common to all locations. It is in this type of traffic that peculiarities of the locale, traditions, and preferred practices of individual terminal- or vessel-operators show up, yet general cargo movements most frequently will govern procedures and handling methods. Therefore, all generalizations about general cargo are hazardous, and such problems as transit shed and yard requirements, apron widths, and equipment selection remain controversial. Three basic trends, however, all quite remote from the majority of today's standard general cargo operation, are of significance in the planning of future terminals:

¶ Specialization of terminals (by providing separate berths for different types of cargo), the unit-load concept, and containerization will permit much greater mechanization of terminal operations than has been known for general cargo in the past. These mechanized facilities will require optimum utilization of each berth to realize full economies.

¶ Increases will tend to occur in all unit capacities, for carriers and for terminals. Whether carrier capacity increases with speed or with size, or both, will have the same general effect on the terminal. Each carrier unit will haul more cargo per year, will require expeditious access to and egress from the terminal, and quick turnaround. The effect of this will be to provide more cargo through each terminal unit (and fewer units as a result, for a given cargo volume).

¶ Emphasis on efficiency of transfer and handling of cargo in containers will tend to cause dispersal (to inland locations) of many auxiliary functions presently associated with the waterfront. Customs inspection, sorting, and much of the in-transit and long-term storage logically would take place in the locations where containers are loaded and unloaded. As a direct consequence, much of the atmosphere of the "teeming port" may disappear.

The above trends, and others of like nature, should be given consideration in the planning of ports, regardless of geographical location. It sometimes is assumed that such trends are of little importance in economically emergent regions. However, it will be the same ships and the same cargo at either end of the voyage, and the inland distribution or cargo handling methods forming local bottlenecks in these regions may not necessarily follow the tedious chronological history of more industrialized nations. In fact, the development of adequate facilities within the near future may be accelerated beyond expectations for two reasons:

First, the construction of new terminals and of the connecting highways and railroads can proceed in many developing areas without the need for cumbersome relocation or remodeling of existing, and probably antiquated, facilities.

Second, there is a growing interest in the concept of "systems approach" to transportation, which, while encountering much skepticism, is now the subject of serious discussion at such meetings as the recent Technical Conference of the International Cargo Handling Coordination Association (New York, September 1961). The "systems approach," encompassing the movement of cargo from shipper to consignee, envisions containerization of large quantities of general package-freight in standardized, van-size units at factories or in regional consolidation centers, and delivery

of the unopened container to the door of the consignee or to inland distribution centers. Between these centers, the movement of containers is centrally controlled and scheduled by an integrated system, the ship and inland carriers serving as links in the system and the ports, equally controlled regardless of location, serving primarily as transfer points between these links.

The cargo volume and the administrative coordination required for economical operation of such a service may make it initially unfeasible on minor trade routes. Its application on the major routes, however, might be encouraged by the success in recent years of container and "piggy-back" services on United States and European railroads (another form of integrated transportation) and by three major ocean carriers now engaged in U. S. domestic, all-container services. (One is in coast-wide trade between Atlantic and Gulf coast ports, a second one is between the West Coast and Hawaii, and the third is between the East Coast and Puerto Rico.)

### Aims and Measures

The primary aim of port planning is the development of terminals and related facilities that can satisfy all needs of present and future traffic efficiently; its potential is governed by the physical, economic, and political limitations of the environment. Because of the interdependence of traffic and terminals, one measure of success can be the volume of traffic attracted by the terminal facilities (an item frequently quite difficult to identify). And a measure of the utilization of available sites within a port is the effectiveness with which all requirements of the community and region can be served.

Only experience can verify the ultimate success or failure of port planning, and, normally, there is much that must remain in the realm of speculation when development potentials are assessed.

## Docks and Harbors

# The Sea and its Bed

ENGINEERING FIRMS engaged in harbor work on both coastal and inland navigable waters are familiar with the procedures required for government approval of projects: the U. S. Army Engineer Corps issues permits for construction of water-front structures and establishes and controls harbor lines, setting the location and limits of structure. The U. S. Coast and Geodetic Survey supplies hydrographic charts and information about currents, tides, and wind velocities.

*An aerial view of dredging operations under way to deepen the outer harbor of the Port of Corpus Christi, Texas.*

*A ladder-type bucket dredge at work in the Port of Palm Beach, Florida. Gee & Jenson is consultant for the project.*

Hydrographic charts and other data usually are also available from the Department of the Navy.

The Unified Soil Classification System of the U. S. Army Engineers Waterways Experiment Station and the Soil Classification Chart of the Mississippi River Commission generally are used in making underwater studies for this harbor work.

In no field of structural engineering work is the preliminary study of soil and rock formation more important than in harbor design. While the U. S. Coast and Geodetic Survey hydrographic charts provide general information for preliminary studies, a project of any magnitude requires a more detailed hydrographic survey of the specific area involved.

David R. Miller, projects director, Daniel, Mann, Johnson & Mendenhall, reports that, as a result of experience in several major oceanographic investigations for pipeline projects, future major harbor surveys will include more extensive use of electronic distance measuring equipment and echo sounding sediment probe devices to speed up this work. Excellent results also are obtained by using skin diver geologists to make underwater explorations and to collect samples of rock outcrops and sediments. In the conventional method of obtaining underwater samples, borings and probings from barges and pontoons usually are taken at 250-ft to 500-ft centers over areas to be dredged. For silt or clay, the Shelby sampler often is employed. For rock, wash boring equipment ordinarily is used, supplemented by a core-drilling machine using core barrels or diamond bits.

Another method of studying underwater strata, without drilling and taking cores for visual examination, is the geophysical survey. There are four major methods of performing geophysical surveys: gravitational, magnetic, electrical, and seismic. Dames & Moore report that the refraction method of seismic surveying is particularly adapted to determining the depth to a consolidated layer or bedrock.

L. T. Evans, foundation engineer, has found that in soils investigation for harbor structures a system of soil profiles is invaluable. These profiles should be obtained from a system of test holes supplemented with the driving performance of a series of test piles. The soils profiles not only give the designing engineer a good picture of the general area but also are of value in assisting in the determination of the length of the piles and in assuring that tips of piles do not terminate in soft clay lenses.

Undisturbed soil samples should be obtained from each test hole for laboratory use. It is the Evans firm's practice to make numerous shear and consolidation tests on these samples. The foundation investigation report determines whether the structure can bear directly upon the soil or whether driven bearing piles must be used.

If rock fills are employed, the study should indicate the critical slopes of the native soils for the loads involved. On projects where bearing piles are required, the report should contain "penetration-capacity" data, and a statement concerning the presence or absence of any soils which might cause a drag down on the piles. Whenever possible, the foundation investigation report should include data on possible scour which would tend to undermine rock fills or decrease the effective length of pile penetration.

*Pier 30-32 at the Port of San Francisco, which was formed by filling in between two narrow piers to make one wide pier.*

## Docks and Harbors

# Fingers from the Shore

PIER AND WHARF design in the United States has departed almost completely from the heavy masonry construction often seen in older European port works. Concrete and steel construction in various forms generally has been adopted in this country. Even in Europe the trend has been to light, reinforced concrete relieving type platforms supported on piles, generally of prestressed concrete.

Wharf and pier construction falls into two general categories: open construction with decks supported by piles or cylinders; and closed or solid construction, such as sheet pile cells, bulkheads, caissons, cribs, and gravity quay walls. Wooden piling has been supplanted by precast, prestressed concrete piles, which may be prestressed up to 800 psi to support 200 tons. A concrete with 5000-lb strength at 28 days is used. Sheet steel and H type piling also is used extensively, but cathodic protection generally is required to prevent excessive corrosion. Steel H piles have been found suitable for driving in long lengths.

Loads involved in design take into consideration docking impact, to be dampened by fendering systems; lateral forces from mooring lines; earthquake forces; and vertical loads involving structural dead weight and live loads from trucks, cranes, railroad cars, and locomotives. General cargo piers usually are

designed for live loads from 600 to 800 lb per sq ft, but unusually heavy cargo or military use may call for greater design loads.

Marginal wharf designs frequently are adopted, particularly where the water is too deep to make finger piers economical to build. Where finger piers are used, the old narrow type has given way to a much wider facility with ample aprons for maneuvering fork lift trucks and mobile cranes. In some instances, the older narrow finger piers have been made wider by filling the slip between two of the piers to provide truck and trackage facilities and more transit shed and warehouse space.

**Typical Examples**

The San Francisco Port Authority joined two finger piers, Piers 30-32, in this way to provide a depressed area in the center for easy truck access to the wide transit sheds on either side. A similar project was carried out by joining Piers 15 and 17.

San Francisco is now in the planning stage of its new Army Street Terminal, which will cost about $28 million and provide seven berths and three transit sheds. Construction of the pier will involve some difficult problems, because the site includes the bottom of an old submarine valley with mud 120-ft deep. The mud will have to be removed by dredging and replaced by sand, then faced with rock in the upper portion to provide stable soil. The marginal wharf will be carried on prestressed concrete piles extending 75 feet into the sand fill. One of the more difficult problems will be the disposal of the dredged waste. The San Francisco Port Authority is doing the design work, with John Blume & Associates as consultant. Dames & Moore made the preliminary soils studies, and Harding Engineers is the consultant on dredging and waste disposal.

San Diego's new 10th Avenue Terminal is an example of the marginal wharf type design which was chosen in preference to two equivalent finger piers. The marginal wharf is ½-mile long and permits simultaneous berthing of nine ocean-going cargo ships. A firm sand and clay bottom permitted the use of a gravity type quay wall which provides an adjacent water depth of 37 feet. In cross section it resembles a gravity dam with a vertical face and a 1:1 back slope. It is constructed of cyclopean concrete, with underwater placement of rocks – weighing up to 7 tons – and Portland cement. About 2 million cubic yards of hydraulic dredged fill was pumped behind the completed wall. The wharf, which is protected by tubular rubber fenders, has unusually wide side aprons and spacious loading areas.

Daniel, Mann, Johnson & Mendenhall, Los Angeles, has done some interesting design work as part of its Indoport studies for the Indonesian government and for reconstruction of piers at Pearl Harbor. The Port

*Three additional berths and two new sheds, being built in an expansion program at Garden Terminal in Savannah.*

*Concrete pile caps, used to brace, support, and fireproof driver piles at Pier 9, at Port of New York in Brooklyn.*

of Pontianak, Borneo, will have a wharf structure designed for a uniform live load of about 600 lbs sq ft.

Ironwood for piles is plentiful in Borneo, but there are no roads or other facilities for getting it out. The small number of piles required and the remote location indicated prestressing would not be economical, and therefore precast concrete was selected. Since lengths may run as much as 140 feet, the engineers designed a special splice to permit the handling of shorter lengths, connecting them at the site.

In the reconstruction of berthing facilities at Pearl Harbor, the piles had to be capable of loads of 50 tons, since a liveload capacity of 750 lbs per sq ft was required. Prestressed concrete piles, ranging in length to 155 feet, were chosen as the most economical type.

Holmes & Narver, Inc., designed the new marine terminal of Richfield Oil Corp., at Long Beach, California. The tank farm and the three reinforced concrete docks are supported in 40 feet of water on precast, reinforced concrete piles with 2500 linear feet of cathodic-protected sheet steel pile cellular bulkheads. The design was complicated by subsidence, which now has been arrested by pumping sea water into the ground. Dames & Moore made the soils studies.

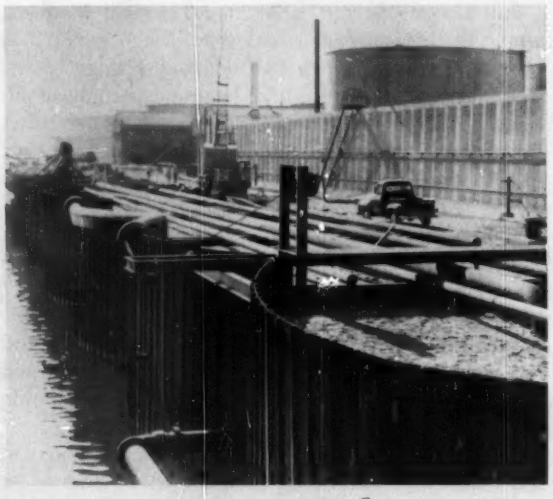
Port of Seattle's Pier 28 project, costing $6 million, is to be completed in 1963. It will provide berthing facilities for three ships, and is designed for general cargo handling as well as a limited container operation. The apron is constructed on two levels. The area on which the gantry crane rails and railroad track is located is depressed 18 inches so that the rails may be laid on ballast. Two sizes of prestressed concrete piles are used to support the apron — 16½-in. octagonal sections for a design load of 100 tons; and 14-in.

*A circular-cell, connecting-arc pier with concrete deck, being built for Nova Scotia Pulp on Cape Breton Island.*

square sections for a design load of 85 tons. Pile lengths up to 130 feet will be used, with pile caps of reinforced concrete spaced at 20-ft centers. The deck is constructed of prestressed, precast concrete slabs 6-ft wide and 20-ft long. Slabs are prestressed for positive moment only. Mild steel reinforcement is provided in the top of each panel, and is welded over the pile cap to provide full continuity in the deck.

The deck structure is designed to support a 50-ton traveling gantry crane, Coopers E-50 railroad loading, and a 30-ton fork-lift truck, or a uniform live load of 750 lb per sq ft. A rubber fender system can absorb

*Pulpwood unloading whaf on the St. Lawrence River, built at Waddington for the Power Authority of New York State.*



*Sheet steel pile cellular bulkheads for the Richfield Oil Company marine terminal facility at Long Beach, Calif.*

the energy of a 25,000-ton ship striking the apron with a velocity of 2 fps at an angle of 10 degrees.

Chas. T. Main, Inc., Boston, Massachusetts, has designed several interesting pier structures. Hoosac Pier No. 1, Boston, has a straight steel sheet piling wall. A relieving platform is used to reduce the loading on the steel sheet piling to adapt it for use in this depth of water (35 feet at MLW). The relieving platform is concrete on timber piles. The tie-back system is built into the relieving platform and includes batter piles to resist horizontal forces.

A pier designed by Chas. T. Main, for Nova Scotia Pulp Limited on Cape Breton Island, is of the circular cell type with connecting arcs. A concrete deck will be constructed on top of the cells and will overhang slightly to form a straight edge to the pier. A timber curb at the deck edge with suspended rubber cylinders provides adequate fendering.

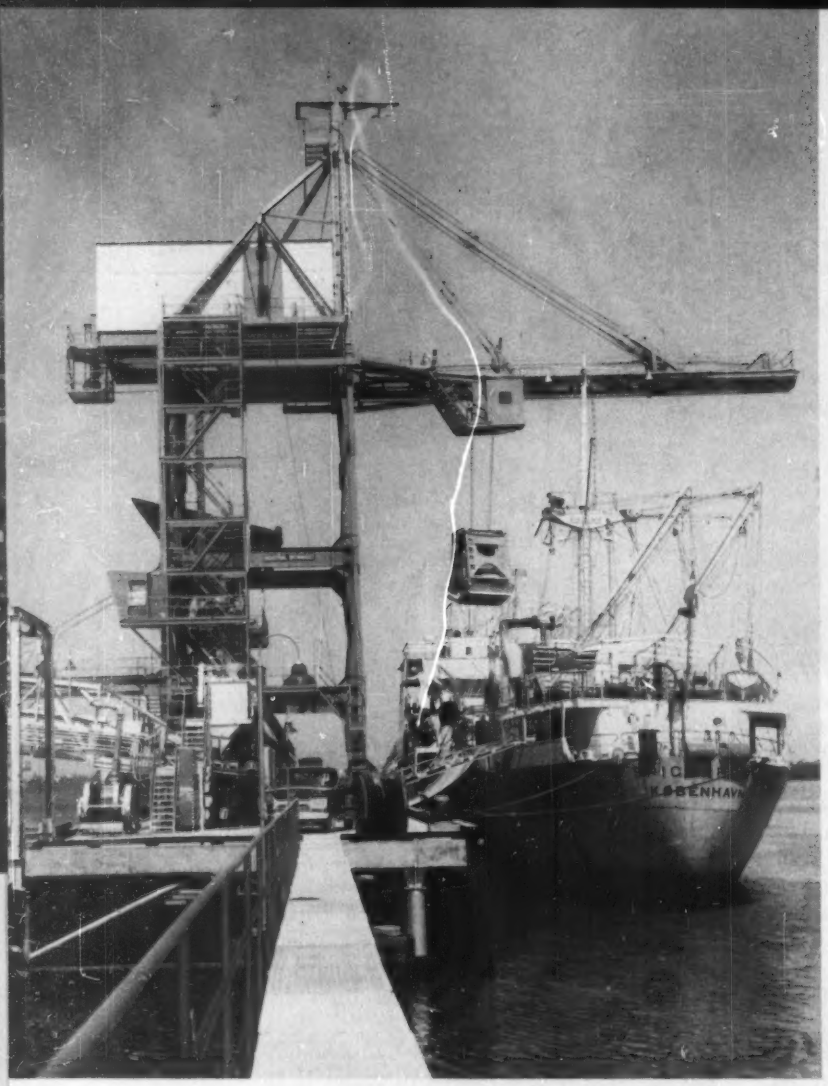
An unusual pulpwood unloading wharf at Waddington, New York, on the St. Lawrence River, also was designed by Chas. T. Main. It was built on dry land, before the flooding of the area by the St. Lawrence Seaway development. The wharf was built with rock-filled steel sheet piling cells, and is a diaphragm type with a concrete slab on top of the fill within the outline of the sheet piling arcs.

Gee & Jensen, Consulting Engineers, Inc., West Palm Beach, Florida, designed the new piers for the Port of Palm Beach. Two wide finger piers provide ample areas for transit sheds and warehouse. Slip No. 1 is constructed with concrete sheet piling with a relieving platform to support a railroad spur. Slip No. 2 was constructed of steel sheet piling with precast concrete deadman anchors. A heavy concrete cap covers the piling from the top to the low water line.

Palmer and Baker Engineers, Inc., in association with Hayes, Seay, Mattern & Mattern, designed Norfolk & Western Railway's Coal Pier No. 6 at Lambert's Point, Norfolk, Virginia. This pier will be 1600-ft long and 82-ft wide, with an initial depth of water of 40 feet, to accommodate 35,000 and 45,000-ton colliers. Each of two loaders will deliver 10,000 tons of coal per hour. The pier is of reinforced concrete, supported on 24-in. prestressed concrete piles, 80-ft long. A steel sheet pile bulkhead 970-ft long has been placed at the pier's inshore end.

Port of New York Authority has undertaken one of the largest pier construction programs in the United States. It will cost approximately $90 million when completed in 1963. Most of the design work has been done by the Port Authority, but the firm of J. E. Greiner & Company, Baltimore, did the design work for Brooklyn Piers 3 and 10 in association with the Port Authority engineering staff. Piers 1, 2, 3, 6, 7, 10 and 11 are completed; Pier 8 is under construction.

The original 25 narrow finger piers were replaced by 11 new structures designed for a uniform live load of 500 lbs per sq ft, and the standard H20 and S16 truck loading. The design finally adopted has a cast-in-place reinforced concrete deck, without the usual pile caps, supported on fireproofed, creosoted timber friction piles with a design capacity of 25 tons. To fireproof the piles, a reinforced concrete pipe is placed over the piles and filled with concrete. The concrete pipe has the advantage of being a self-supporting element, requiring little bracing to maintain its position. It is also capable of supporting the deck formwork prior to being filled with concrete. This design detail has been used on all subsequent Port Authority projects, including the Port of Newark.



Docks and Harbors

# Shortening Shore Leave

*A clam shell bucket, suspended from a gantry, for handling bulk cargo at the Port of New Orleans.*

MECHANIZATION of cargo handling has greatly influenced design of piers, wharf aprons, transit sheds, and warehouses. Loadings of structures must take into consideration not only the dead load, but the live loads imposed by equipment such as trucks, lift trucks, mobile cranes, overhead cranes, and belt conveyors. Bulk cargo handling introduces additional design problems.

Grain elevator design, for example, long has been a specialty of some engineering firms. R. E. Pacquer, project engineer for Marshall, Barr and Associates, Seattle, designed an 830,000 bushel grain elevator for the Long Beach Harbor Department, with a ship-loading capacity of 1300 tons per hour. Ultimate storage capacity of this facility will be 9 million bushels. Trucks can be unloaded with a hydraulic truck dumper at the rate of 12, 20-ton trucks per hour. Box cars can be unloaded at a rate of 8, 50-ton cars per hour. Grain can be received via air conveyors with a capacity of 150 tons per hour, and can discharge either to the elevator proper, to steel tanks near the dock, or directly to rail cars or trucks.

Since the Long Beach elevator was to be constructed in a maximum earthquake zone, a 13 percent earthquake factor without deductions for multiple stories was used. This earthquake factor was applied not only to the dead load, but also to 100 percent of the live load. The workhouse, 50-ft square and towering 216 feet above ground level, utilizes the floors as horizontal diaphragms to carry the loads to the exterior walls which, in turn, were figured as vertical diaphragms. Interior columns were far too flexible to help resist seismic loads. The loads in the storage cells were carried down the walls as a unit. Slipform construction, of reinforced Class A concrete, was used for the workhouse and storage cells.

Soil loads for the workhouse are approximately 9000 lbs per sq ft, while storage loads are about 7000 lbs per

sq ft. Since approximately 60 feet of relatively new noncompacted fill was encountered above dense natural sands, the foundation loads were carried by long tip-bearing piles founded in the natural sands below. These piles also were required to resist lateral movement due to earthquake. After investigation, 63-foot long, 18-in. octagonal prestressed concrete piles, driven to 100-ton bearing capacity, were selected. A total of 32,000 lineal feet of piling was used. The piles were jetted to within a few feet of the final position and thoroughly back-filled and compacted around their upper 15 feet to resist seismic loads.

**Bulk Handling Systems**

Ore loading and unloading has been speeded up by using belt conveyor installations. One of the most modern is that of the Reserve Mining Co., at its Taconite processing plant at Silver Bay on Lake Superior.

Loading facilities include two belt-type boat loaders arranged to receive iron ore pellets from any one of ten belt feeders extending from five storage bins. Their rated capacity is 3550 tons per hour, discharged directly into the ore carriers. A 60-in. belt conveyor, equipped with a retractable shuttle and boom, discharges the material into the ore boats from each loader. The boat loaders move horizontally by rail across the face of the pellet storage bins and also along the side of the ore boat.

The loaders are anchored when not in operation and during storm and high wind conditions. An anemometer on each loader, connected with a voltmeter, automatically interlocks the rail clamps and secures the boat loader when wind velocity reaches 38 mph.

Portland Public Docks, Portland, Oregon, has installed a new 900-ton per hour bulk unloader at Terminal No. 4. The unloading tower is a rope trolley machine with the trolley runway or apron extending 57 feet beyond the face of the dock. This outboard apron is hinged and swings up out of the way for ship clearance, when required. The trolley runway extends through the tower and 50 feet beyond it to the landward so that the bucket can reclaim from a stockpile on the dock. The trolley runway is 81 feet above the top of the dock.

Bulk ores picked up by the clamshell bucket are dumped into a 2000-cu ft capacity hopper, thence through either of two variable speed apron feeders, each of which serves its own individual stationary 1400-cu ft weigh hopper. The weigh hoppers are serviced by semi-automatic electronic scales, allowing the operator to set them to a predetermined quantity. The 50-ton capacity scales dump through a 14-ft duplex gate at the bottom of the hopper.

**Containerization**

For a number of years, containerization of general merchandise cargo using highway type trailer vans has been receiving the attention of nearly every major steamship, railroad, and trucking company in the United States. Door-to-door local deliveries are integrated with a long sea or rail haul without any break-bulk operation in between.

The two largest container ship operations in the United States are the Sea-Land Service between Newark, New Jersey and Florida, Texas, and Puerto Rico, and the Matson Navigation Co. operation from San Francisco and Los Angeles to Hawaii.

The principal advantage of containerization is in reduction of the cost of cargo handling and reduction in the turn-around time of the ships. The loading rate of the Sea-Land trailerships is 264 tons per hour per stevedoring gang. With conventional cargo, a loading rate of 40 tons per hour would be normal. Matson has found that the container ship Hawaiian Citizen can be unloaded and reloaded in less than 24 hours, as compared with three to four days port time for conventionally loaded cargo ships.

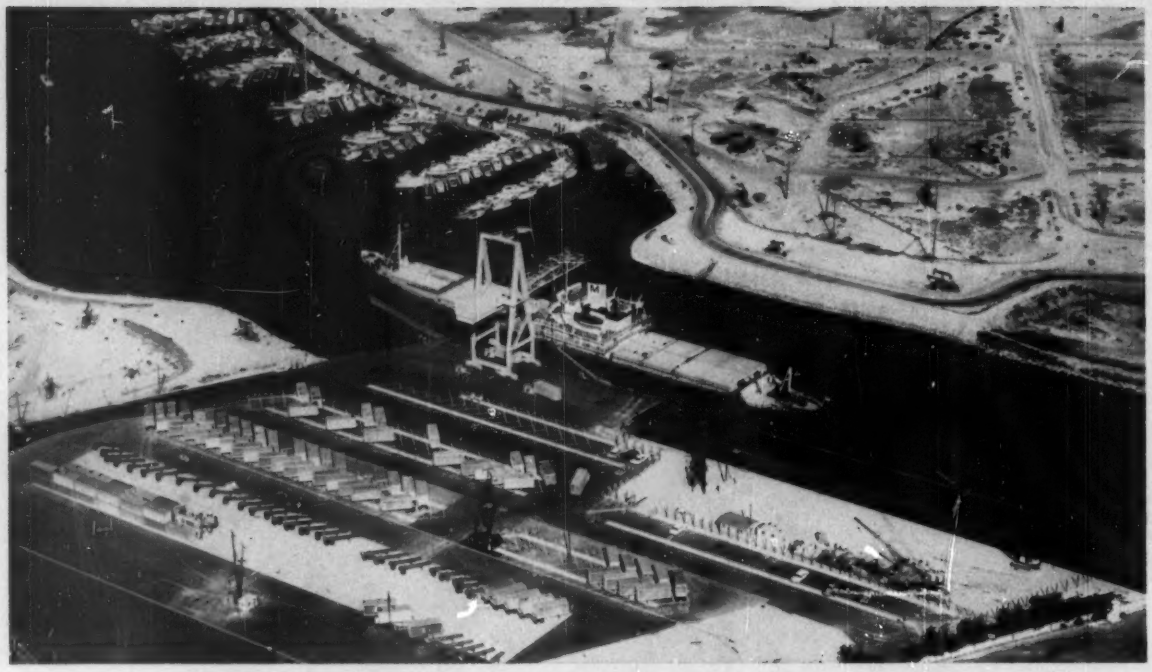
Pilferage, the bane of conventional cargo handling, has been reduced to the vanishing point by containerization. Two million silver dollars recently were shipped unguarded in Sea-Land vans from Washington, D.C. to San Juan. Shippers have found that shipping by containers simplifies their packaging. Food staples move in consumer packaging, ready for the food market shelves. Sides of beef are simply hung from the rails of the refrigerated container.

The pronounced success of Sea-Land Service was due in part to another factor in addition to containerization. An economic study showed that it is cheaper to transport highway vans from Port Newark, New Jersey to Jacksonville and Houston by trailership than by overland trucking operations. The cost of maintenance, fuel, operators, and taxes and licenses in every state traversed made truck travel uneconomical.

The saving in cargo handling costs has, however, been offset in part by the demands of maritime labor for a lion's share of the savings – not only the longshoremen, but also the seafaring unions are involved. In the United States these demands have been met by royalty agreements or automation and mechanization payments. Grace Line has not yet been able to resolve the problem raised by the demands of the stevedores at La Guaria, Venezuela.

Container terminal facilities are relatively simple; cranes handle the transfer of the containers. Some, such as those for Matson and Puget Sound-Alaska Van Lines, are on the piers. Others, such as those for Sea-Land Service, Grace Line, and other companies, are mounted on the ships. These are usually gantry type cranes of 25-ton capacity – in line with the customary highway loading restriction for trailer vans.

Other requirements are the necessary ship berthing, an adjacent container marshalling yard, preferably paved and with direct connection to highway and rail



*The Matson terminal facility at Wilmington Harbor, in Los Angeles, California, showing the container marshalling yards and the special crane designed to transfer containers from the ship holds to dock-side straddle trucks.*

networks, and equipment for handling containers in the marshalling yard. This would consist of trailer trucks and straddle carriers or, occasionally, heavy duty fork lift trucks. In some instances, where less than full container loads are expected, an assembly and break-bulk facility under lock and cover will be required. Electric service for refrigerated containers also is required, and a marshalling yard office and possibly an equipment maintenance shop would complete the principal facilities.

Several of the other major East Coast and Gulf ports are making provision in their recently-designed harbor structures for accommodating the container shipping services. In this regard, the firm of Lockwood Greene Engineers, Incorporated, of Spartanburg, South Carolina, is incorporating two new concepts of design for their new pier project at Lambert Point, in Norfolk, Virginia. The first of these new features is the use of removable cargo hatches on the roof of the transit shed. This will allow the loading or unloading of containerized cargo directly from the ship to the inside of the transit shed. To augment interior lighting in the shed, the coverings on the removable hatches is of a translucent material. Thus, the hatches can serve as skylights even when the hatch covers are in place.

The other new feature is a semiportable gantry crane that may be used on either side of the pier. The transfer from one side to the other is accomplished by means of curved tracks at the corners of the pier, one curved track being embedded in the deck and the other located on the roof of the transit shed.

**Fueling Facilities**

Adequate bunkering facilities are also an important factor in speeding up ship turn-around time, and

*Fueling facilities at Newport News, Virginia, on a separate pier adjacent to the bulk handling piers for ore and coal.*

hence are a vital influence in attracting ships to a particular port. Ship owners prefer to fuel at mooring berths to reduce turn-around time as much as possible. This can be done either by barges and oilers or by a pumping system provided on the docks. In some locations, separate fueling piers have been constructed adjacent to large bulk-loading piers where ore and coal is handled, such as the Chesapeake and Ohio Railway Co. fuel handling facilities at Newport News. At the Port of New Orleans, bunkering facilities are provided by large fuel barges which pull alongside ships moored to docks. No time is lost; cargo loading and unloading and fueling are done simultaneously.

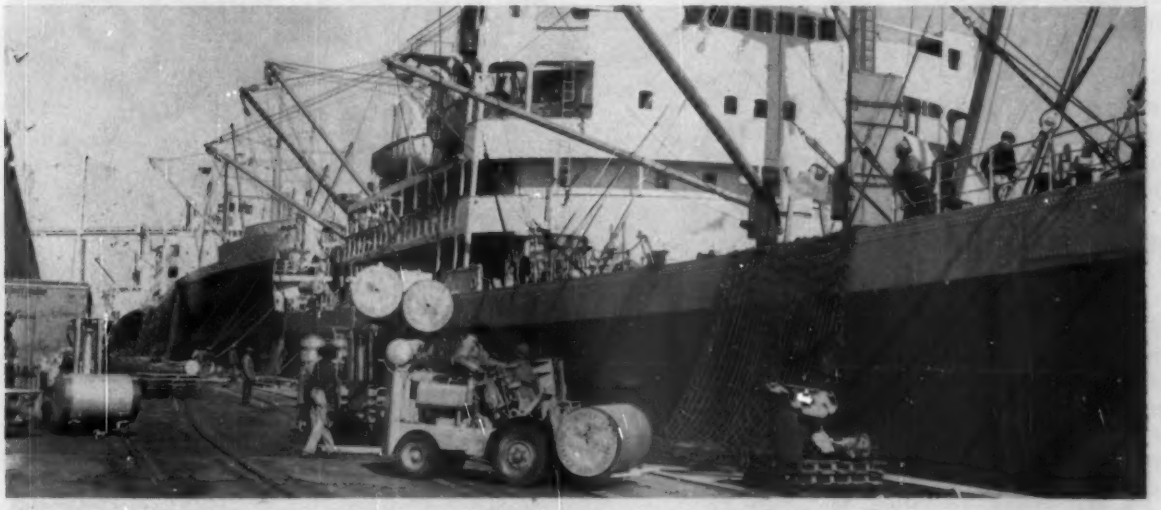
One of the most modern fueling systems is the Port of San Diego's berthside bunkering at the Tenth Avenue Terminal, where ships may take on fuel at any of the nine berths and load and unload cargo at the same time. Three bunkering pipe lines from 6-in. to 10-in. diameter run from the pumping station adjacent to the storage tank area to the nine fueling stations along the wharf perimeter. Each fueling station has three, 6-in. loading risers, one serving each bunkering line.

Bunker C and light domestic fuel oil lines are handled in common system so that they may be used interchangeably. The two lines are cross-connected at the farthest end, permitting the displacement of the heavier Bunker C, which has to be heated for easier pumping, by the more fluid light domestic oil. A separate diesel oil system prevents contamination of this fuel. Isolating valves were installed at the long outboard face of the wharf. Two unloading lines, one 14-in. for Bunker C and light domestic fuels and a separate 12-in. diesel oil line, run from the unloading berth or receiving station on the northwest face of the wharf to the storage tanks. Each line has two, 8-in. unloading risers in underground pits.

*A cargo ship being refueled simultaneously with loading and unloading operations at the Port of San Diego, Calif.*

At present five pumps are used for handling the three types of fuels. Three are 1000-bbl per hr, 700-gpm centrifugal pumps driven by 125-hp electric motors – one used solely for diesel fuel; the second for light domestic oil; and the third, a standby, for either light domestic or Bunker C. The other two pumps, of the rotary type, handle the Bunker C fuel.

Ballast water pumped into empty fuel tanks of ships contains oil residues and cannot be discharged into harbor water. Before refueling, this water is pumped out and heavier oil is removed by a weir box. An air flotation separator takes out lighter oils before the water is discharged to a storm sewer.



*A view of the Columbus Street Pier, at the Port of Charleston, South Carolina. There are two different types of lift trucks that are being used on the dock to unload the cargo of newsprint from the freighter in the foreground.*

# Docks and Harbors

# Passengers and Cargo

TERMINAL STRUCTURE design has met the challenge for more rapid movement of passengers, baggage, and cargo. Most of the cargo terminals are single story structures, while the dual-purpose passenger and cargo terminals are sometimes two-level structures with complete separation of cargo and passengers. In the latest design, cabs and local transportation media have access to the upper passenger level without any interference from cargo movement on the lower level.

Port buildings include transit sheds for temporary storage to receive cargo from vessels and from trucks or railway carriers for shipment, and warehouses for longer periods of storage. Other structures may include separate buildings for customs, administration, police station and guardhouse, fire station, and power house, particularly if generation facilities are required in areas not convenient to a dependable source of power. Drydocks, an essential facility for repair and overhauling, are found in all the larger harbors.

Port buildings involve all the structural, mechanical, and electrical design problems involved in inland-based structures, plus the problems of less stable subsoil conditions, unusual waste disposal and water supply systems, fire protection, and power supply and lighting at the water front where special grounding provisions often have to be made. An intercommunication system is essential between buildings and ships at berth, and between loading equipment.

### Typical Examples

Port of New Orleans is a fresh water port, but, when the new 77-mile deepwater canal is completed in 1963,

*Over-all view of Los Angeles Harbor. In foreground is the man-made peninsula which will become a super-tanker terminal.*

*A new warehouse under construction behind existing facilities at the Tenth Avenue Terminal, San Diego, California.*

*McGuire Chemical Co. terminal at Oakland has facilities for mixing, packaging, and shipping other firms' products.*

it will connect the port with the Gulf by sea-level route almost 40 miles shorter than the present Mississippi River passage. It has 14 miles of quay-type wharves and deep water terminals parallelling the harbor banks. In addition to its general cargo wharves, it has a large public grain elevator, ore handling facilities, and is a major oil terminal. A port improvement program begun in 1958 will cost $131 million by 1970.

Typical of these improvements is the Nashville Avenue terminal with a 62-ft wide apron, double marginal rail tracks, and a concrete deck designed for loads up to 850 lbs per sq ft. It has a four-berth marginal wharf. The transit shed will be 350-ft deep. It will be supported by concrete and steel H piling. An underpass for trucks eliminates any interference with rail car movements.

Puerto Rico Ports Authority controls all the island ports, including San Juan, Ponce, and Mayaguez. San Juan has 10 marginal wharf terminals and three of the finger pier type. One finger pier with two berths is now being converted to a tourist facility. At the southeastern part of the bay, bulkheads are being constructed to provide 13 additional berths. The port authority has used consulting engineers for port studies and designs.

Port of Corpus Christi, Texas, is a man-made port created in 1922. Today navigable water extends 9½ miles; the main basin is 5500-ft long, 1000-ft wide, and 35-ft deep. Plans have been made to dredge the channel to a depth of 43 feet. The latest addition to the port is a bulk materials handling dock with a traveling unloading tower. Noted for its cotton shipping facilities, it also is now recognized as one of the major Gulf ports for chemicals, ores, and cement.

Maryland Port Authority, Baltimore, maintains a small planning and design staff, but plans and specifications for major facilities are prepared by consulting engineers. Turpin Wachter & Associates prepared the master plan of the new Dundalk Marine Terminal, Port of Baltimore, to cost $21 million when completed. It will provide marginal berthing areas for eight ships, a 50-ft wide apron, transit sheds with a total floor area of 96,000 square feet per berth adjacent to the apron, and a fully-integrated plan for truck and rail service. A nearby supporting yard will accommodate 500 rail cars, and a rectangular grid system of roads for truck access. The present port facilities are used to store thousands of imported foreign automobiles, making it the third largest car importation port in the United States.

Port of Los Angeles has started the construction of a two-story passenger and cargo terminal which will be completed in 1962 at an estimated cost of $15 million. A general cargo terminal facility at Berths 143-144, including the wharf and transit shed, recently was completed at a cost of $4 million. A grain terminal at Berth 174 is now in operation with a capacity of 17,000 bushels per hour. A comprehensive development plan has been adopted by the Los Angeles Harbor Commission, calling for future expenditures of $36,690,000 for 12,000 lineal feet of wharves and 30 acres of clear span transit sheds.

Port of Oakland, California, is an entirely separate port authority from San Francisco. It operates an Outer Harbor Terminal complex with 336,030 square feet of space, which is leased to Encinal Terminals; and the Inner Harbor for which plans are now underway to expand bulk handling facilities. One of the unusual Port of Oakland facilities is the new chemical terminal operated by McGuire Chemical Co., in the Outer Harbor. It does not make or market a single product of its own, but offers storage, mixing, packag-

*Passenger and cargo terminals at Berths 142 and 143, Los Angeles Harbor. These terminals were recently completed.*

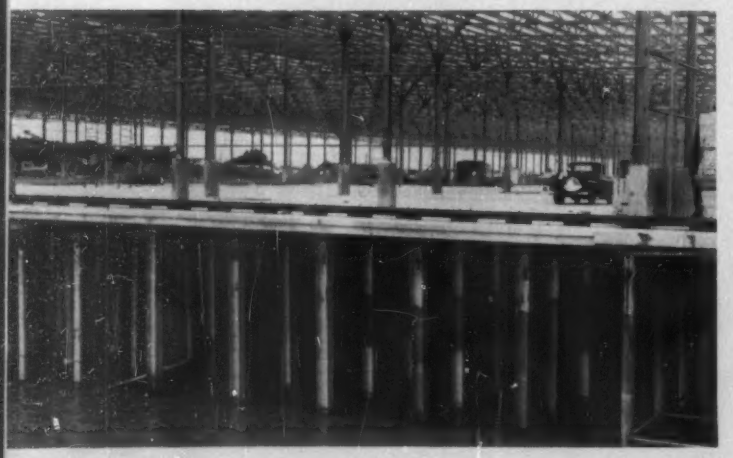
ing, and shipping facilities for chemicals for other companies. It has 60,000 square feet of warehouse space and 49 storage tanks for chemicals, ranging from 3000 to 420,000-gal. capacity. Similar terminal facilities are available at the ports of Los Angeles and Vancouver, Washington.

Port of San Diego's new Tenth Avenue Terminal has two transit sheds having several interesting design features, and has under construction two warehouses adjacent to the sheds. All structures, including the marginal wharf, were designed under the direction of J. E. Liebman, chief engineer of the Port, and Greer Ferver, structural consulting engineer, in association with the engineering and architectural firm of Freeland & Bird.

Each of the transit sheds has a clear width between side walls of 200 feet, and the 964-ft length is divided into four, 240-ft rooms. Columns, spaced at 60-ft intervals, are located to provide a 100-ft center aisle with two, 50-ft side aisles. Division walls are 12-in. thick to prevent the spread of fire from one room to another. End walls are 8-in. thick. Longitudinal side walls are 6-in. thick concrete of tilt-up construction. Roofs of the sheds are poured-in-place gypsum carried on steel purlins and steel roof trusses. The roof is waterproofed with a 15-year bonded built-up roof topped with crushed rock.

Because of the length of the buildings and the possibility of differential settlements along the sidewalls, the sidewalls were not made structurally continuous. The roof deck is designed as a diaphragm to distribute horizontal forces in shear. The buildings have no skylights or monitors, and, except for the cargo checker's office and toilet rooms, no windows.

W. L. Lipscomb Engineering, Inc., designed the electrical distribution system for the Tenth Avenue Terminal. The incoming 12 kv feeder is metered at primary voltage; service is 3-phase, 3-wire, 60 cycle. Two, 12 kv sub-feeders extend underground from the main 12 kv switchgear to form a modified loop system. Each of the two feeders is available through 15 kv load break oil switches located in various manholes. Transformer and distribution switchboards are located inside the buildings, and provide a 208-volt, 3-phase, 4-wire system for lighting and miscellaneous power, and a 480-volt, 3-phase, 3-wire system for motor loads. Telephone, fire alarm, and communications circuits are distributed underground through separate manholes and extend into various buildings. Fluorescent light is used throughout the interior, and mercury street lighting and flood lighting is provided for the exterior.



*The steel H-section piling and superstructure at the Nashville Avenue Terminal, at the Port of New Orleans, La.*

*What will be the largest dry dock in the world, being built at Puget Sound Naval Shipyard, Bremerton, Washington.*

# Docks and Harbors

# For Sailors And Stinkpotters

*Access ramp, 43-ft long, leading to walkway floats, Shilshole Bay Marina, Seattle.*

INCREASING POPULARITY of aquatic sports has stimulated demands for the construction of marinas or small craft harbors all over the United States, on both coastal and inland waterways. It is estimated that there are now over 8 million pleasure craft, and the sport is attracting 100,000 new boat owners annually.

Harbor and service facilities for this booming activity have lagged far behind the needs of boat owners. Some of the earlier small craft harbors did not have the benefit of professional design help, and as a result there are many substandard marina operations. More recently, consulting engineers have been retained to design small craft harbors and shore structures. Marinas are being built in practically every state of the union, with rivers and man-made lakes created by dams also serving as waterways. The greatest impetus for marina construction, however, has been in the areas where small craft can be used year-round, such as the Florida coastal waters, the Gulf, and the West Coast.

Basic design considerations are the same for both commercial shipping and marina harbors, but piers and land-based structures, of course, are considerably different. Piers are designed for a live load ranging from 25 lbs per sq ft up to 400 lbs per sq ft, with the heavier design loadings used when heavy trucks are to be driven on a pier. Where natural conditions do not afford protection from high waters, tides, and winds, breakwaters must be constructed. Marinas with floating piers require breakwater protection to keep wave height down to one foot or less. These breakwaters may be rip-rap mound; braced single row piles; double row piles, filled; timber cribs; precast concrete cylinders with caps; or caissons.

The harbor entrance for small craft should be located at a point where the natural bottom is at least the project depth of the harbor and where it will cause a minimum exposure from approaching waves. Wave refraction and diffraction diagrams have been found useful in determining the most desirable harbor site. At river sites, and in areas subject to extensive littoral drift, entrance shoaling is an important factor in harbor design. Contour maps of the surface of underwater areas often are prepared as a part of the construction plans.

Fixed berthing slips sometimes are provided where water-level fluctuations are less than 4 feet, but floating slips generally are used where this range is exceeded. In a floating system fixed in place by piles, only two or three piles are in continuous contact with

the collars, and only these need rollers. Floats for floating berths are made of lightweight concrete, fiberglass-reinforced plastics, and epoxy-coated steel-tubes. Launching ramps generally are constructed of concrete, either poured-in-place or precast.

California has been particularly active in the planning and construction of small craft harbors. However, it was not until the passage of legislation in 1957, setting up a new Division of Small Craft Harbors and a Small Craft Harbors Commission to establish policies, that planning and construction really got under way. The law provides for loans to cities, counties, or districts having power to acquire, construct, and operate small craft harbors. The legislature made $5 million available for this purpose, and a referendum approved by the voters in 1958 made an additional $10 million available through a bond issue. In 1960, the commission drew up regulations requiring that the engineering and financial feasibility studies for construction loans be prepared by separate consulting firms when the amount is in excess of $150,000.

As of January 1, 1960, 27 small craft harbor projects under the control of the Commission were in various stages of planning, design, and construction. These projects, such as San Diego's Mission Bay, have been locally financed. In a few instances, the engineering has been done by the harbor district, but most of the design work is being handled by consulting engineers.

### Typical Examples

Leeds, Hill and Jewett is the consultant for Oceanside harbor, which will have mooring facilities for 574 boats up to 70-ft long, with tie-down provisions for 50 more. The channel of the 100-acre harbor will be dredged to a 20-ft depth with a 10-ft slip depth.

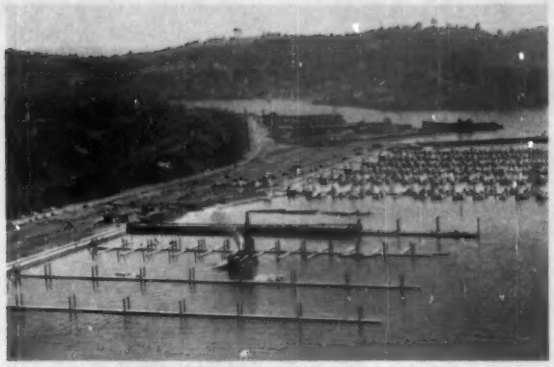
Heffron & Moulton, engineering and architectural firm, is the consultant for the small craft harbor at Pittsburg, California. Dames & Moore did the soils engineering work, and Ralston and Dwyer was the consulting mechanical and electrical engineer. The harbor is located at the confluence of the Sacramento and San Joaquin rivers, 40 miles from San Francisco.

An unusual feature of this marina is the 1200-ft long rock-protected peat breakwater. The 7½-acre basin, dredged from 5 to 7 feet below MLLW, will have 166 covered berths 20-ft to 50-ft long, 24 open single berths 20-ft long, 30 open tie-ups at floating docks, and an 80-ft long fueling dock. A two-lane launching ramp is a city block removed from the main harbor. Pittsburgh received a $450,000 loan from the State of California, and the remainder of the estimated $600,000 cost will come from the city and a concessionaire.

Site conditions posed an interesting design problem to Dames & Moore, the soils consultant. The water is only a few feet deep at maximum, but the underlying material is peat to about 80 feet. Adjacent and parallel to the breakwater line is the main deep-water channel to Sacramento and Stockton. The harbor excavation consisted primarily of peat removal.

A structural breakwater design was considered, but the great depth of the peat would have necessitated long piles with batter piles for axial loading. This would have priced the project out of existence. Therefore, the breakwater was designed for levee protection on the channel side with a 6-in. rock bedding layer of 4-in. maximum rock size, covered by a 12-in.

*The recently completed Long Beach Marina, at Alamos Bay in Southern California. Four separate boat basins contain more than 1800 slips for 20-ft to 80-ft craft. The 3300-ft rock jetties provide a protected entrance channel.*



*New floats under construction, part of the expansion of Shilshole Bay Marina at the Port of Seattle, Washington.*

*A peat-filled, rock-protected breakwater, constructed for the new small craft harbor at Pittsburg, California.*

rock layer of 200-lb maximum size. A similar revetment was placed on the harbor side. Design elevation was plus 8 feet with the top width 20 feet. On the river side, slopes were 3:1; on the harbor side, 2:1.

Koebig & Koebig, Inc., is the engineering consultant for the Redondo Beach King Harbor with berthing for 1000 boats and a large adjacent parking area. The over-all cost will be $30 million, including $6 million for the breakwater, $9 million for the inner harbor, and $15 million for leased facilities.

Although the outer harbor breakwater was built by the U. S. Army Corps of Engineers in 1958, sufficient protection for a marina was not afforded. It was decided to design the marina harbor, using earthen moles with enclosing arms protected by stone revetments. The inside perimeter of the two larger basins is trimmed with a 5-ft high concrete retaining wall founded on top of the revetment stone at elevation + 5 feet MLLW. Outside slopes of the moles facing the breakwater have a heavier blanket of stone carried up to the top of the fill at elevation + 12 feet. Sidewalks and handrails complete the trim line.

One of the three boat basins, built in the downtown area, is long and narrow with a short channel connecting it to the harbor. Along the entire length of this lagoon will be built a row of attractive concrete shopping structures with a roof deck serving as a promenade overlooking the basin. A natural lagoon for swimming was built nearby, but separate from the boat basin area. Water in the lagoon is heated by warm water pumped from a nearby power plant.

George S. Nolte and Noble Harbor Engineering, a joint venture, designed the Redwood City Marina. The design provides for 120 boat berths having timber decks and lightweight concrete flotation units. Approximately 14,000 cubic yards of dredging was required. Structures include a harbor master's office, wharf with sailboat hoist, two comfort stations, and a sewage treatment plant.

John A. Blume & Associates has been retained for planning and design consultation on four California marinas. The City of Berkeley is adding 403 new berths to the existing 204 berths in its yacht harbor, originally constructed with WPA funds in 1936. Wind and wave studies, using refraction and diffraction diagrams, were made by Blume & Associates to establish optimum location and alignment of the entrance channel and protecting breakwater. Construction plans call for development in incremental stages to permit completion after initial subsidence of tideland areas reclaimed by sanitary fill.

South San Francisco has been utilizing its 56 acres of tideland on the shore of San Francisco Bay as a sanitary fill operation to provide future recreational facilities. The nucleus of this development will be a small craft harbor which will include 286 floating berths of 25, 30, 36, and 42-ft length, with power and water facilities and space for a small locker at each berth. Large lockers will be available on the platforms at the head of each main float. A double lane concrete launching ramp with service floats will be located at the outer end of the harbor. Dry storage will be provided for 50 trailer-borne boats until additional filled land is available. It then will be replaced by a 100-boat dry-storage building. The berthing basin will be formed by the existing shore on the west, the sanitary fill on the south, and a cantilevered timber pile breakwater on the north. It will be closed on the east, except for the entrance, with a dike having a core of sanitary fill to reduce weight of fill on the underlying bay mud. Structures will include a harbor master's office and rest rooms, sales building, fuel dock, dry storage, and restaurant. A beach and picnic area and nine-hole golf course are also included in the plans.

Ventura Port District plans a marina with berthing facilities for 2300 boats and launching capacity to

serve 650 trailer-borne boats per day. Fuel dock, yacht club, repair yard, rest rooms, chandlery, boat sales, motel, and restaurants are included in the plans.

The principal engineering problem was the design of the protective jetties for the entrance channel. The two jetties will converge, making the entrance at the outer end relatively narrow to attenuate wave energy. The entrance system was tested in the hydraulic model laboratory of John A. Blume & Associates, Research Division, confirming the effectiveness of the design. Test data indicated storm waves would be less than one foot in height in the berthing basin. Rock and tribars were the options included in the design as the major armor for outer ends of jetties. The tribar design brought the lowest bid.

Moffatt & Nichol, Inc., George F. Nicholson, and J. W. B. Blackmon were consulting engineers for the recently completed Long Beach Marina at Alamos Bay. Four boat basins contain over 1800 slips for craft ranging from 20-ft to 80-ft in length. Two, 3300-ft long rock jetties create a 400-ft wide protected entrance channel from the ocean to the marina and Alamitos Bay. The channel is dredged to a depth of 15 to 20 feet below MLLW. The perimeter of the basins consists of a gravity concrete wall supported by rock and bearing piles. Floats are constructed of wood resting on fiberglass-reinforced plastic pontoons. Fresh water and electricity are provided for all slips.

Provision has been made for a large boat repair yard adjacent to the mooring areas. One vertical lift elevator handles boats up to 30-ft long, and a second handles boats up to 60-ft long. Concrete launching ramps for small boats are located nearby.

San Diego's Mission Bay Aquatic Park will have one of the largest areas for marina development in the United States. There will be a separation of sail from power boat areas with sufficient slips to accommodate 12,000 boats, providing 2500 acres of water and 2100 acres of land for recreation and boating facilities. Shore facilities will include motels, restaurants, fuel docks, boat sales and maintenance buildings, and clubhouses. Except for the administration building and public rest room and bathhouse structures, all shore facilities will be built by private interests.

The U. S. Army Corps of Engineers dredged the West Bay area and the adjacent San Diego River flood channel to a 20-ft depth at mean low water. The City of San Diego dredged the East Bay areas, used for power boats, to a minimum 7-ft depth. The dredged material was used to construct Cabrillo Island. In creating the island, a clean sand dredged from the West Bay area and entrance channel was used to form a dike outlining the shores of the new island. Silt dredged from the East Bay area was pumped into the diked area. Clean sand below the silt then was removed by the dredge and pumped over the silt to raise the island to the desired level above the water. Shorelines needing protection were revetted with rock. When completed, the total cost in public funds will be $35 million, and $50 million will be invested in Mission Bay by private interests.

Not all marinas are built by public agencies. An example of privately financed small craft harbors is the Jack London Square Marina under construction at Oakland. The yacht harbor, as presently planned, will have 89 berths, but when the new Oakland-Alameda tube is completed, it will be extended to 200 berths. Another privately financed harbor is the Oakland Marina with berths for 159 boats.

Fisherman's Wharf, San Francisco, may not strictly fall in the category of a marina, but the City of San Francisco has some plans to develop a large part of the area as an Aquatic Park, retaining all the tourist attractions of the present restaurant and shopping area. John S. Bolles-Ernest Born, architects, and Hayes & Little, consulting engineers, are working on the plans to modernize the area. A passenger ship terminal and waterfront auditorium to seat 17,000 persons are part of the major Embarcadero redevelopment project, but are not included in the master plan.

Shilshole Bay Marina, a joint venture of the Port of Seattle and the U. S. Army Corps of Engineers, will cost $8.5 million when finally completed. It will provide moorage for nearly 1600 boats. The Army Engineers built the ¾-mile rock mound breakwater and dredged the basins. The Port of Seattle designed and built the shoreside facilities, the docks, and the nearly completed $1 million administration and restaurant building. In additon to the 4400-ft breakwater constructed by the Engineer Corps along the west side of the basin, the Port of Seattle built a plank-faced timber breakwater pier to protect the southerly portion of the basin and a plank-faced steel frame spur breakwater at the north end.

Moorage is provided by a series of 8-ft wide main walkway floats to which are attached wing floats. Boats are berthed at both sides of wing floats. The floats are assembled from pontoons, principally 6-ft by 8-ft and 4-ft by 10-ft, consisting of laminated flexible timber wales to give flexibility to the entire unit. The critical point of this assembly is where wing floats are joined to the walkway floats, as the design had to take into consideration eight forces, many of which occur simultaneously. Floats are moored by timber anchor and guide piles driven along the main walkway floats and at the ends of wing floats.

Ramps 43-ft long were used to cross from the promenade along the bulkhead to the floats. They bridge the rock tee of the bulkhead and are designed to maintain a maximum 30 degree slope in an 18-ft maximum tidal range. Bulkhead structures, 10-ft high gravity concrete sections on creosoted timber piling with graded quarry rock fill below, were made by driving piling, placing rock fill, and then casting the concrete wall. ▲▲

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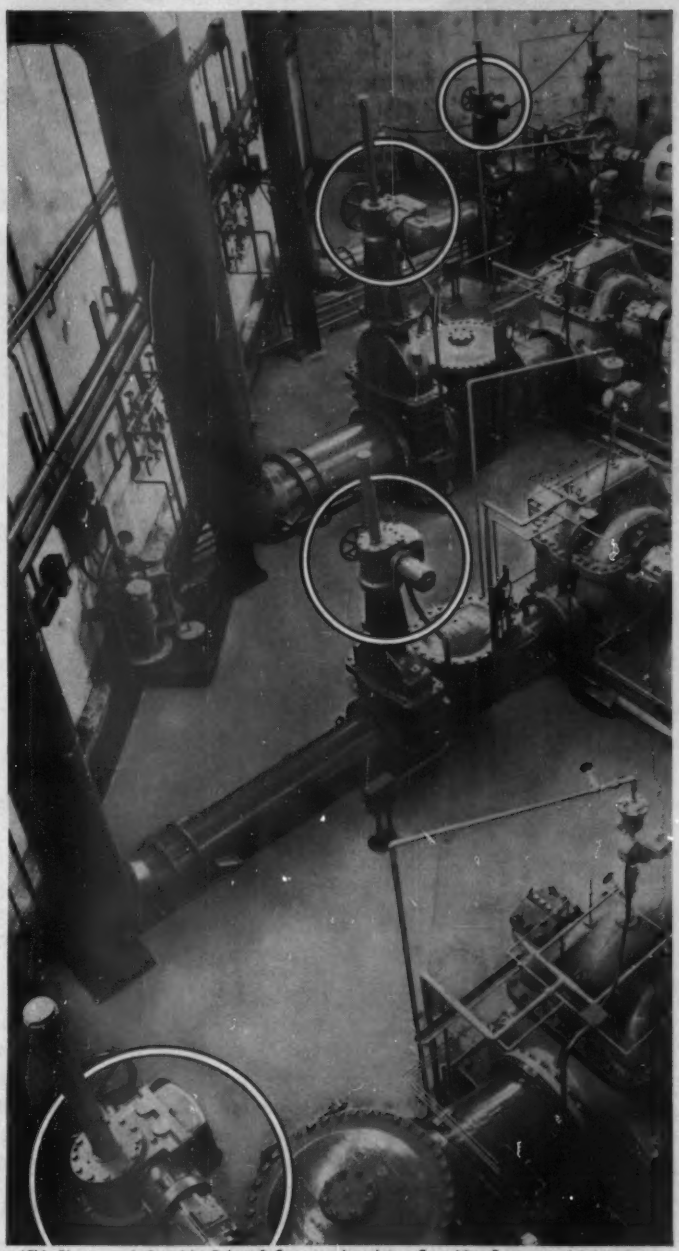

*This Plant was designed by Robert & Company Associates, Consulting Engineers, Atlanta, Ga.

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*Tapered steel girders and rectangular tube purlins form the main mall canopy at the Philips Highway Plaza, Jacksonville,*

# Esthetics of Exposed Structural Steel

VICTOR SANTORO, Throop & Feiden

THE ESTHETIC EFFECT achieved by exposing the structural elements of buildings is a relatively recent phenomenon. Past practice frequently dictated that columns, beams, girders, and other structural members be concealed, because it was felt that they detracted from the over-all beauty of the structure. Today, many buildings and their auxiliary structures present convincing evidence that skillful treatment of exposed beams and columns can produce a striking effect, one that can be duplicated by no other method.

CE exclusive

The engineer, who must coordinate all the activities of the owner, contractor, and manufacturer, must of necessity be familiar with all the available techniques relating to construction and design. He must realize the limitations and potential of these techniques, in order to use them to their fullest in projects employing exposed structural elements.

### Esthetic Results Demand Cooperation

Research by the steel industry has contributed several innovations that have given the engineer greater flexibility in the planning and design of steel structures. A variety of new high-strength steels and several new WF shapes are examples. Continuing investigation and study by the steel industry probably

will yield even more promising results, specifically adaptable to exposed steel structures.

New erection techniques, born of the contractors' past experience, have aided substantially in transforming into reality this newly developing concept of a monolithic exposed steel structure.

Foresight and imagination also have been exhibited by the owner. Although primarily concerned with acquiring the most economical structure consistent with his requirements, he has a sense of responsibility to esthetics. Without the approval of the owner, whether he be a land developer, school board, or hospital administrator, relatively little esthetic progress could be expected.

### Exposed Steel in Shopping Centers

Although exposed rigid steel frames have been used in auditoriums, cafeterias, gymnasiums, and other large enclosed areas, the use of exposed steel is best exemplified by a study of canopy and covered walk framing used in shopping centers.

Basically, the great majority of shopping centers is composed of one or more buildings fronting on one or both sides of a mall. The individual store units making up a building have their entrances covered by a canopy serving several purposes: protection from rain and snow; support for a sun screen; and continuity of building line, by tying the individual store units and the buildings together into one basic unit. The leading edge of the canopy is one of the basic elements used to convey an appearance of continuity.

### Continuous Fascia Members

The use of structural steel shapes for continuous fascia members requires special precautions to insure that the esthetic beauty of the structure is not impaired. To illustrate: the permissible mill tolerance in the cut length is plus or minus ¾ inch for structural shapes under 30 feet in length. This tolerance is quite acceptable for ordinary structural framing. However, in shopping center canopies, when 20-ft lengths of structural steel shapes are used for the canopy fascia, the standard tolerance is not acceptable. Possible ¾-in. gaps could occur at the abutting ends of the members and thus destroy the desired effect of continuity.

To eliminate the possible occurrence of large gaps, the ends of each member must be milled to provide a ¼-in. gap between members. This ¼-in. allowance is necessary to provide for expansion of the member after fabrication and before erection, and to insure further that the members will not be oversized.

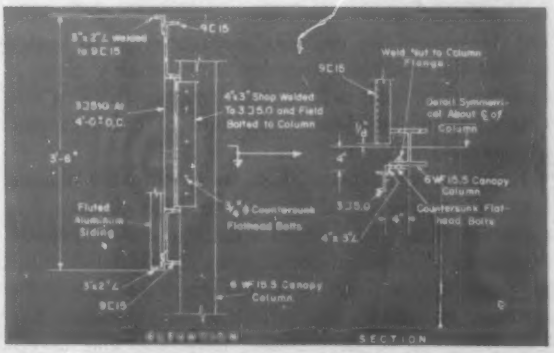
### Straightness and Alignment

Straightness and alignment of fascia members are additional problems, since structural shapes are subject to mill and field tolerances. Furthermore, after erection, and when subjected to temperature variations, a fascia member may buckle out between column supports. This buckling must be avoided if an unbroken straight line is to be maintained when several hundred feet of continuous canopy fascia is planned for a building front.

One detail devised to correct for this condition was used at the mid-span of the 9[15 canopy fascia member at Colonial Park Shopping Center, Harrisburg, Pennsylvania. The canopy decking consisted of an exposed 4½-in. deep fluted steel member running parallel to the fascia member and the building line, and supported by transverse steel beams at the canopy columns.

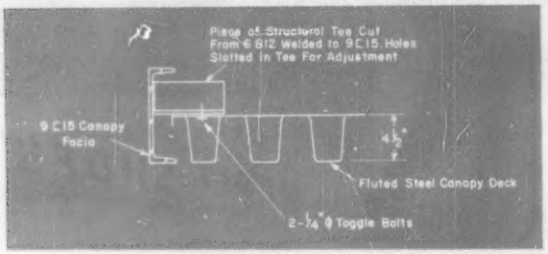
Alignment of the channel fascia was accomplished by using a piece of structural tee bolted and braced to the 4½-in. deep steel deck. The detail required that the steel erector align the fascia member after the steel decking was placed by another subcontractor. This did not place any undue hardship on either erector, nor did it add to the cost of erection, since the subcontractors coordinated their respective erection schedules. Also, the size of the project re-

*A front view of the sun screen at Philips Highway Plaza, showing the unbroken line of fluted aluminum siding used.*




*Connection detail, showing the attachment of the sun screen to canopy columns with countersunk flathead bolts.*

*Continuous exposed steel fascia and fluted steel deck of canopy, supported by beams cantilevering over windows.*


Piece of Structural Tee Cut From ⊕ BI2 Welded to 9 C I5. Holes Slotted In Tee For Adjustment
9 C I5 Canopy Fascia
4½"
Fluted Steel Canopy Deck
2-¼" ⌀ Toggle Bolts

*Section through a canopy, showing the alignment detail of the steel deck which acts as a brace for the fascia.*

quired the steel erector to be on the job long after the decking contractor completed his work.

**Field Bolted Connections**

Contractor preference for and familiarity with field bolting techniques invariably are reflected in their bid prices. It is with this in mind that almost all exposed steel connections are designed for field bolting. However, the engineer must attempt to design so that the resultant structure is reasonably clear of cumbersome, unattractive connections which would detract from the clean sharp lines of the structural shapes used.

Exposed connections that are reasonably distant from the general public can be treated with less attention than those which will be observed closely. However, all exposed connections should be detailed to some degree by the design engineer. Here, the engineer is called upon to utilize his experience and knowledge of structural steel detailing, and to coordinate his knowledge with the esthetic design to effect the desired end result.

Along the sides of the buildings at Philips Highway Plaza, the aluminum canopy deck is supported on an exposed 12[20.7 which runs adjacent to and parallel with the building face. In turn, the 12[20.7 is supported by a 3-in. by 6-in. tube section serving as a beam and framing between the building and a canopy column 12 feet away. The bottom portions of the channel were cut to permit the tube section to pass through. The channel was connected to the tube section with an inverted U-shaped plate hidden behind the channel and shop welded to the tube. Countersunk flathead bolts complete the connection between channel and plate. By the use of a structural channel, the dual purpose of function and esthetics was served. Also, by combining field bolting with countersunk flathead bolts and shop welding, connections can be devised which are esthetically acceptable and which are economically feasible.

**Welded Connections**

In attempting to give structures a truthful expression of the strength inherent in steel, the engineer may encounter situations where the use of field bolting would impair beauty. It is on these occasions that the engineer must resort to both shop and field welding on all exposed connections.

The free-standing crossover canopy proposed for the Eudowood Shopping Center, Baltimore, Maryland, is an example of an all-welded structure. Called the "Butterfly Canopy" because of its light, delicate appearance, its purpose is to protect shoppers walking across the main mall at certain selected points and along the sides of the buildings.

The design uses 3-in. by 4½-in. tube sections for the arms, with 3-in. by 3-in. tube sections forming the column stems of the repeating Y-shaped units. The individual Y units will be shop welded before shipment to the site, where they will be welded together tip to tip. All joints and connections of the tubular steel sections will be bevel cut, welded, and then ground smooth. Based on a 16-ft module, the canopies will vary in length up to a maximum of 144 feet. The units are joined across the canopy by field welding slender 3-in. deep structural tees at the peak, valley, and mid-points of the arms. Corrugated translucent plastic panels, which are to be used for the deck, will be supported by the steel tube arms.

The transverse tees, restricted to 3 inches for architectural reasons, cannot be relied upon to contribute much stability to the structure. However, by fixing the bases of the columns, stability will be attained without any additional bracing of the exposed structure. The column of each Y unit will be anchored to 18-in. by 18-in. square piers with 2¾-in. bolts. These bolts will be drawn up tight after aligning and field welding the arms of the Y

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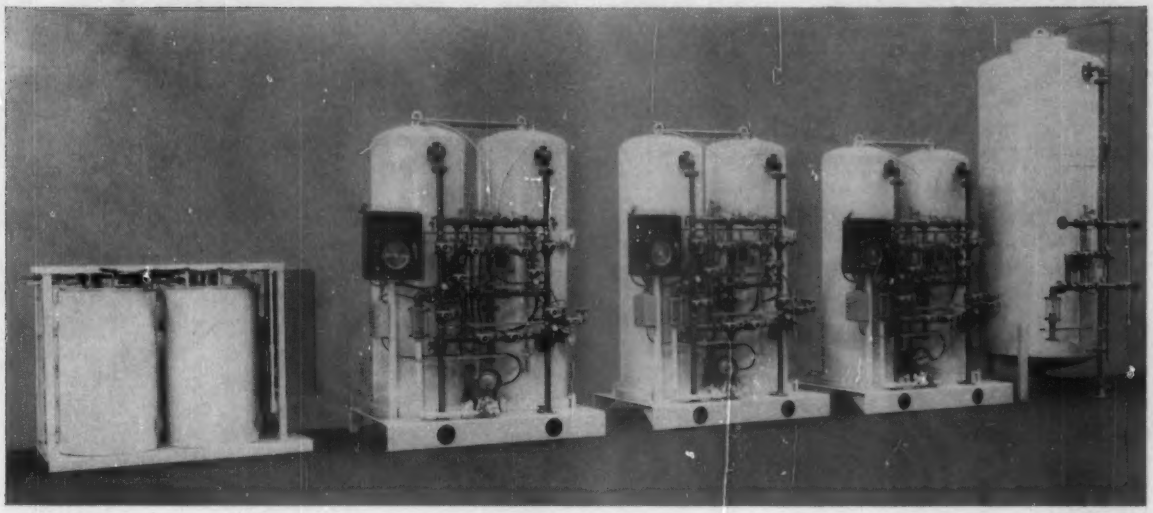

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units together at the peaks. The base of each column then will be encased in a jacket of concrete, 18-in. by 18-in. by 2-ft deep, placed on top of the pier. Vertical reinforcement extending up from the pier will tie the jacket and pier together. Both pier and jacket are set below the mall surface and will not be visible.

Some degree of economy will be realized in this type of canopy from the continuous structural beam effect gained by having the tubular arm connections completely welded. However, these canopies, although appearing relatively simple and light because of the use of tubular sections, are expected to cost more per ton than more conventional framed structure. The additional cost of field welding, augmented by the increased erection labor and time required for perfect alignment of the structure, probably will offset the economy achieved by continuity.

**Use of Shop Fabricated Members**

Welded, tapered, high span girders completely cover the main mall at Philips Highway Plaza, Jacksonville, Florida. The girders, 48-ft long and spaced on approximately 18-ft centers, were composed of steel plates completely welded in the shop. Each girder was shipped to the field in one piece.

Tapering the girders from a depth of 22 inches at the center to 10 inches at each end achieves two purposes. Structural economy is realized by using a deeper section at the center where the greatest bending moment occurs. Esthetically, the striking effect of light outstretching wings of steel is achieved. Also, drainage is provided by the taper. Rain water, running off the vari-colored plastic and corrugated aluminum panels onto the roofs of the buildings on either side, is carried away by gutters concealed from the view of passing shoppers behind the low parapets of the buildings.

The tapered girders rest on 6 WF 15.5 column stubs, which in turn are supported by the building spandrel beams. A bolted connection with slotted holes was employed between the girders and column stubs to allow for expansion and contraction of the girders across the mall. Although shoulder bolts were required at these connections, even at a height of only 20 feet there is hardly any discernible evidence of the bolt heads.

A pleasing trellis effect over the main mall is achieved with rectangular steel tube subpurlins which are placed between the tapered girders to support the corrugated roof panels. Rectangular and square steel tubes of varying sizes are now stock items, readily available from most steel suppliers. The connection of the tube subpurlins to the girders was designed to facilitate placement of the subpurlins by lifting them into place rather than by lowering them down to the connection. This eliminated cutting out the bottom of the tube at the connection, which would be visible from the main mall below.

In almost all instances, bolts were used for the field connections in order to facilitate erection. Only in isolated cases was field welding resorted to in order to maintain a relatively clean uncluttered effect. One instance where field welding was employed occurred at the end of the main mall, where the subpurlins were used as split cantilevers in order to support the overhanging roof deck beyond the last tapered girder.

**Combination Sign and Sun Screens**

At the parking area entrance to the stores in many shopping centers, a continuous sun screen is required. It also may serve as a support for signs advertising the individual store units.

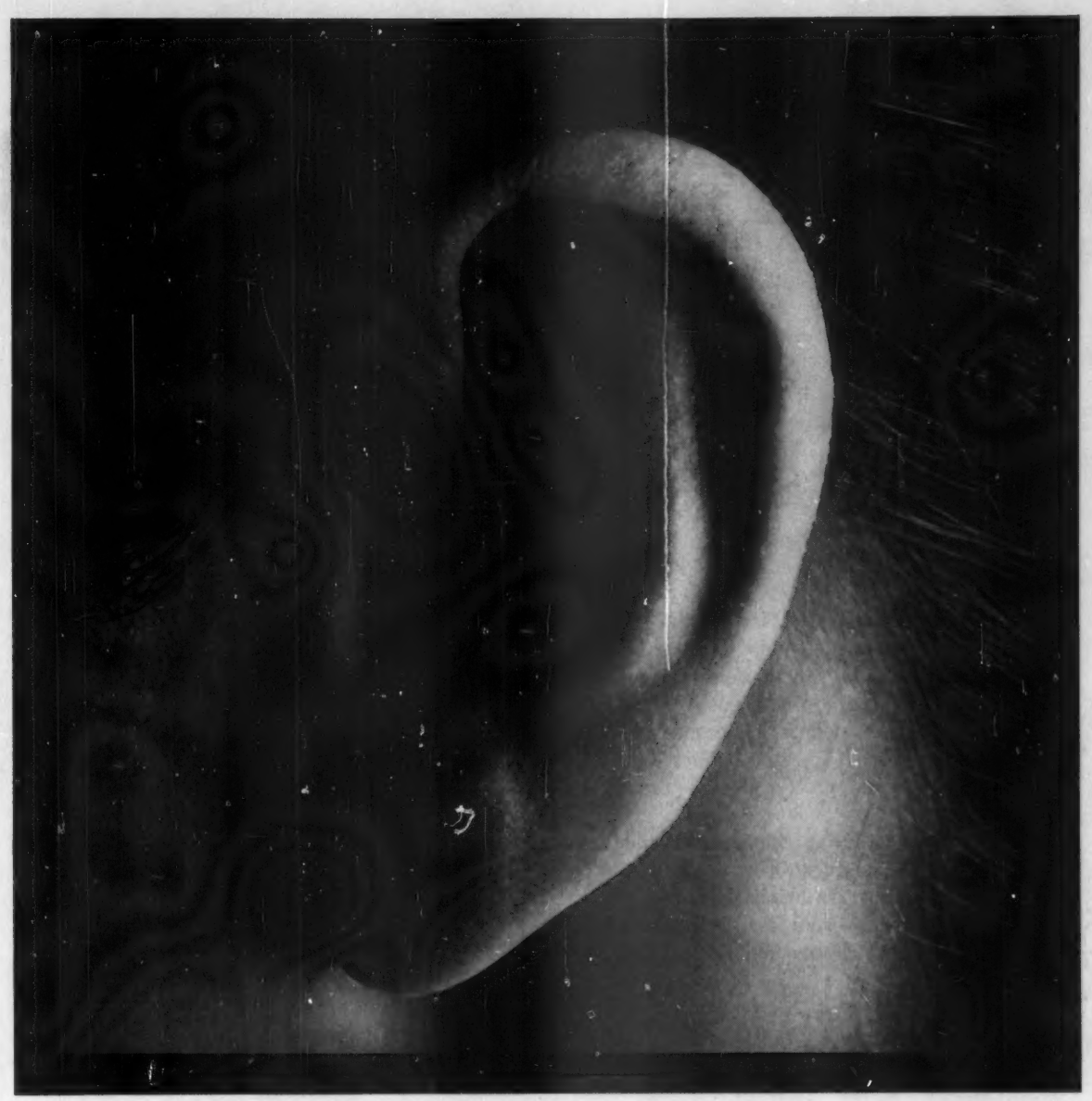
The frames for such sun screens must span between canopy columns, and can be composed of structural channels shop welded together as they would be for a Vierendeel truss. At the Philips Highway Plaza a 9[15 was used for the top and bottom members of the truss frame, with 3[5.0 as verticals on approximately 4-ft centers. A fluted aluminum siding, 1⅛-in. thick, was used for the vertical panel of the sun screen. Each frame was quickly erected in the field by bolting to the 6 WF 15.5 canopy columns. A 4-in. by 3-in. angle, serving as the connection, was shop welded to the vertical 3[5.0 at the end of the frames and bolted to the canopy column, utilizing flathead countersunk bolts.

To preserve the appearance of continuity, only a ¼-in. gap was left between the ends of the frames. Since the frames are 3-ft 6-in. deep, this made it virtually impossible for a workman to get his hand down between the flanges of the column in order to hold the nut during the tightening process. Shop welding the nuts to the inside surface of the column flanges eliminated this problem.

**Exposed Canopy Decks**

For consistency in the concept of exposed structural framing, it is necessary for the canopy deck itself to be exposed. Fluted or corrugated steel, aluminum, and plastic decking are extremely suitable for this purpose. It is necessary, however, to properly maintain the alignment of the flutes or corrugations, so that the effect of continuity is not destroyed when the deck is viewed from below.

Both aluminum and plastic decking can be connected to the exposed steel frame conveniently with metal studs. Steel decking usually is spot welded. Both types of connections are invisible in the completed structure and can withstand uplift pressure resulting from wind force. By using roof decking of this type, the necessity for a ceiling is eliminated and costs are reduced. ▲▲



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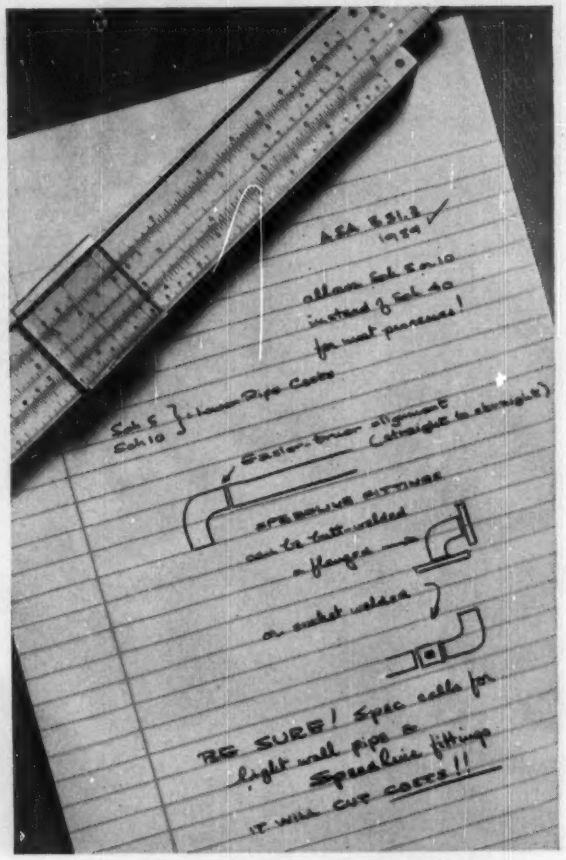


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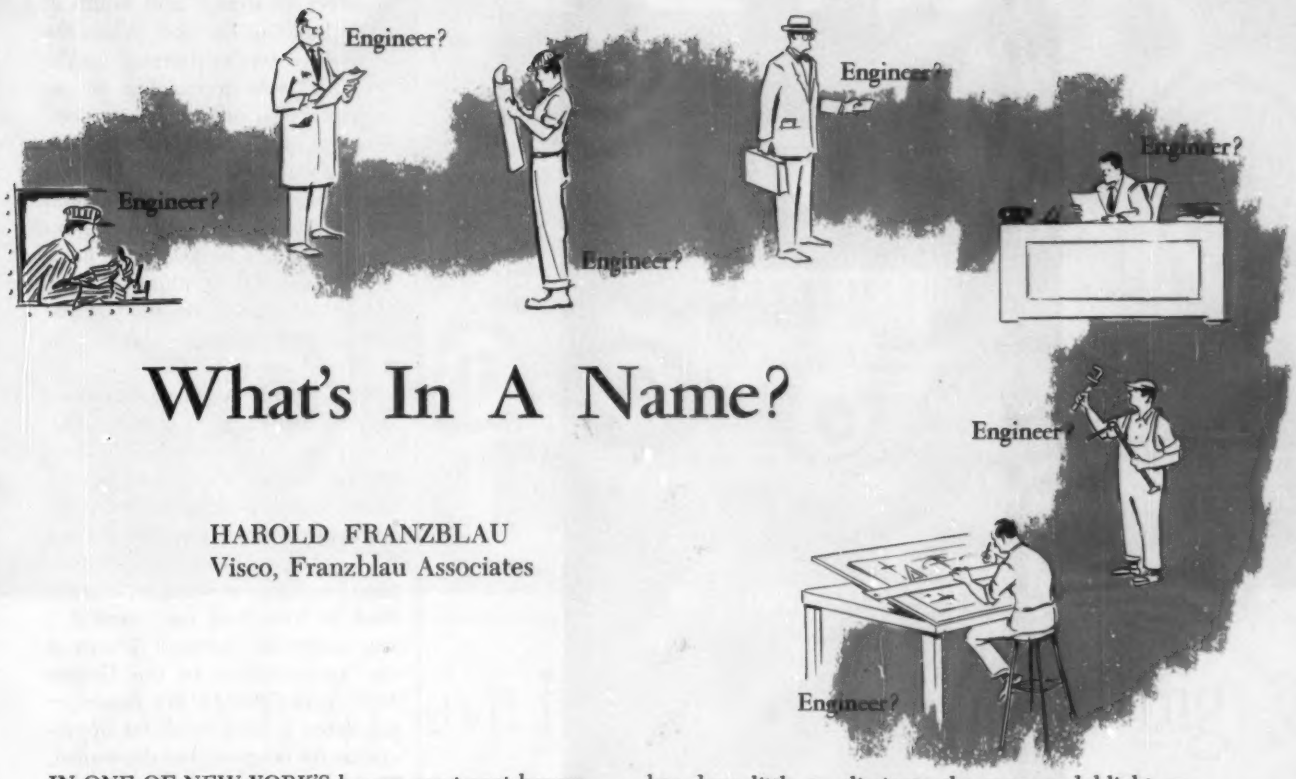


# What's In A Name?

HAROLD FRANZBLAU
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IN ONE OF NEW YORK'S luxury apartment houses, shooting up out of the ground like a permanent outer space launching site, dwells a building custodian—sometimes known as the superintendent. If you are a prospective tenant, you seek him out for a preliminary run through on model apartments — complete with brochures and "inside advice." You leave with a pleasant and totally satisfied feeling that here is the very man to supervise your maintenance and janitorial problems — and in your hand is his business card. It has his name, number, and title: *Engineer.*

Has a man the right to call himself attorney-at-law because he knows the legal procedure for purchasing and selling real estate? Has a man the right to call himself doctor, because he can diagnose measles, postnasal drip, appendicitis, and phlegmasia?

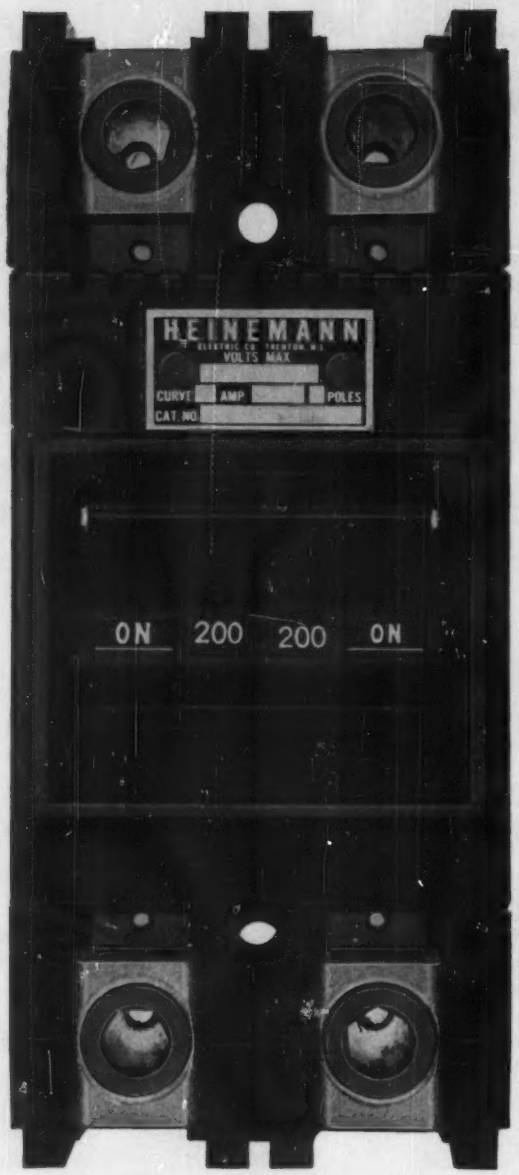
The strong, tooth bearing laws that protect the doctor and the lawyer from promiscuous simulation hold these professions inviolate, but the professional engineer must share his crowded pedestal with Casey Jones, the crane operator, the refrigerator attendant, the boiler stoker, the discharged soldier from the U. S. Army Corps of Engineers, and a wide variety of commercial allies. In practically every state, there is a less than zealous attempt to enforce the law prohibiting the use of "engineer" for commercial activity.

Because the professional engineer has not developed a strong lobby in Washington and his state capitol, he has done little to eliminate the moss and blight on his professional tree. He continues to toil in the serfdom of second class professionalism.

All states by law require the consulting engineer in the construction field to carry a license, but this group is only one of many in the field of engineering — and not the largest. At this time the only kinship between the two groups is that they all boast the same title. The machine designer, the electronic engineer, and the aeronautical engineer do not need a license to practice. On the contrary, all architects must have a license to practice. There are few exceptions, and this helps to establish the field of architecture as a profession. Thus "engineer" may be a misnomer: like "associates," it covers an area of unknown territory.

The consulting engineer offers the client a broad scope of technical and administrative services. In effect, the client is dealing with a professional man to solve his technical problems and a businessman to advise him on his economic problems — both in the same person. Unfortunately, consulting engineers have barely scratched the surface of these combined services. At a recent luncheon, four prominent architects tried to name an engineer who could qualify as a top flight engineer and also as an astute businessman. Only one name was agreed on by the group, and he is the engineer partner in an architectural firm.

Among laymen, the situation is even worse. A real estate man bought a plot of land and engaged an

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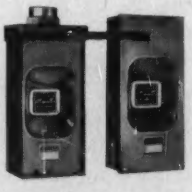

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architect to design and build an office building for him. When the announcement appeared in the press, he was approached by an engineer who offered his services. The real estate man queried, "Why do I need an engineer?" He was completely uninformed, for he had no idea that architects have to engage engineers to design the heating and ventilating, plumbing, and electrical systems. He thought engineers designed only bridges, tunnels, and dams.

An acquaintance of mine told me that he had engaged a termite engineer to service his newly purchased house. This "engineer" knew that the title exterminator displeased his wife, and he did not feel that it did justice to his business. Driving a woman lecturer back to New York one evening, I was caught in a series of detours at the approaches to the George Washington Bridge. My passenger expressed a deep sense of appreciation for progress, but she wailed, "It is a shame the way those architects mess up the roads."

Despite this inaccuracy, the woman's impression of professional accomplishment cannot be considered ignorance. To millions of people the word "architect" means one thing — a person who has something to do with buildings and construction. The architect's position is fairly well defined. On commercial and municipal building projects, the architect usually is the prime consultant. He is the man introduced to the owners, board of trustees, and building committee. Yet in today's complex array of highly technical structures, especially in the industrial fields, the work of the engineer exceeds in scope, intricacy, and responsibility the services of the architect. Between architect and engineer there must be an equitable recognition of each other's responsibility. The engineer must not be a second rate citizen in his own workshop.

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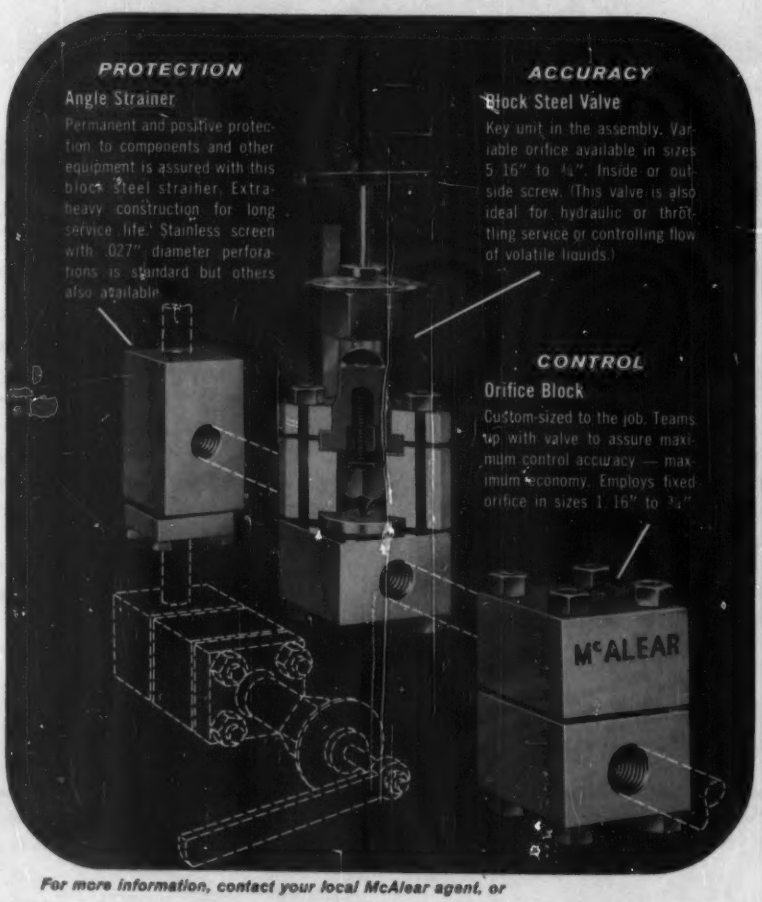
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and diligently to develop good public relations. One proven public relations technique is that of visual dramatization. When Sidney Kingsley's Pulitzer Prize play "Men in White" opened on Broadway, audiences were thrilled by the inside story of what goes on in a hospital. Medical schools noted a rise in student applications, and subsequent programs such as the television show "Medic" created a tremendous sympathy for the doctor and his work. Films based on the life of Florence Nightingale evoked the same enthusiasm for nursing, and when Bing Crosby portrayed a priest in the film "Going My Way," the impact on church attendance was phenomenal.

These dramatizations were simply the stories of men and women practicing their professions. But how about the engineer? Has the engineer ever played the leading role in a drama — Hollywood or Broadway style? The popular Hollywood conception of an engineer is a rugged young construction boss who is hurriedly summoned from a lunch counter — where he is engaged in witty dialogue with a cute waitress — to rescue his men who just got trapped in a cave-in at the dam site.

There is a popular belief that the engineer and his work are uninteresting. Certainly this is not true. The engineer is a basic contributor to technological progress for the advancement of civilization — a public benefactor. He represents a high degree of intellect in his own community and devotes his spare time, knowledge, and energies to many community projects — civic, religious, and social. Yet in large cities, he rarely is known to his own community as an engineer; more often than not, he is without professional identity.

Engineering can and should be living room conversation. A loquacious lawyer will dramatize his courtroom fencing, a certified accountant delights in telling stories of his brush with the Internal Rev-

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**Q.** *What are some of the outstanding physical properties of Simplex polyethylene?*

**A.** Light weight (62% of paper cables) . . . High tensile strength (1800-2000 p.s.i.) . . . High elongation (400% minimum).

**Q.** *Where can Simplex polyethylene cables be used?*

**A.** In many places where rubber or paper cable is used. Typical installations are direct burial, duct or conduit, aerial and submarine.

**Q.** *What is the highest voltage at which Simplex polyethylene cables are rated?*

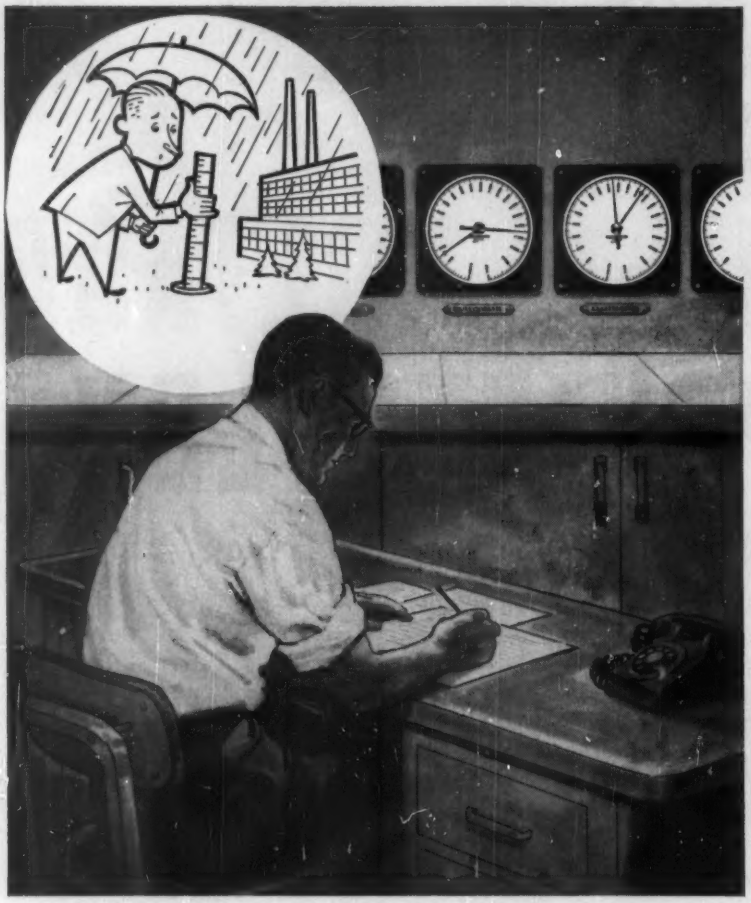
**A.** Simplex now has polyethylene cable rated as high as 46KV A-C. Development work now in progress is expected to extend Simplex polyethylene's voltage range to 69KV or higher.

**Q.** *Has Simplex high voltage polyethylene cable been thoroughly field tested?*

**A.** Yes, as the leading producer of polyethylene cables, Simplex has in service more than 330 mile-years of polyethylene-insulated cable in the 5KV to 46KV range.

*Send for complete information.*

**Simplex**
**WIRE & CABLE CO.**
EXECUTIVE OFFICES: Cambridge, Mass.
*Plants at Cambridge, Mass., Portsmouth, N. H., Westbury, L. I., Monrovia, Calif.*



# Take the legwork out of liquid measurement

Here's practical liquid measuring—the modern way... without roaming all over the lot! Liquidometer Gauges let you inventory distantly stored liquids at a glance.

Completely automatic Liquidometer Gauges can be located as far as 250 feet from tanks. Think what this centralized system can mean in man-hours saved—let alone the additional safety of personnel who no longer have to trudge to, or tamper with, hard-to-get-at tanks.

Simple to install, and requiring no maintenance, Liquidometer Gauges measure virtually all liquids conveniently, continuously, and correctly. There's a type available for practically every liquid measuring application.

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LIQUIDOMETER INSTRUMENTS

THE LIQUIDOMETER CORP.

Dept. C , LONG ISLAND CITY 1, NEW YORK

enue agents, and practically every other profession can be, and is, eased into casual conversation — except engineering! And mainly because the engineer thinks and talks in terms of Smolley, Marks, differential equations, and stress and strain. We must learn to reduce our technical traffic of shop language to free flowing, clearly worded nuggets of conversational information.

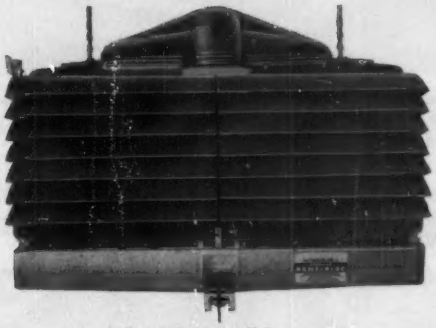
Engineers have thousands of untapped story ideas which, when treated by experienced dramatists, could bring the engineering profession into the limelight. A series of weekly television shows sponsored by large corporations or foundations is one of the simplest and best approaches, and it could be sold if engineers would temporarily lay aside their intraprofessional bickering.

There have been many biographical motion pictures of men and women whose names, as a result, became known to every man, women, and school child. The careers of Edison, Pasteur, Ehrlich, Bell, and Zola portrayed on film created a tremendous interest in their work. There is no reason why the careers of famous engineers could not do the same.

One large firm always uses an engineer — rehearsed, camera shy, and dull — to describe its new consumer products on television. We see and hear this engineer as he tells us that our children will be able to drive a car at 200 mph without looking at the road. This is interesting enough, but perhaps the kids of today would rather know more about the men responsible for the conception and engineering of this remarkable hot rod of the future, not in stilted documentary sequence, but with honest down-to-earth story dialogue. If this idea were thoroughly developed, we might even arrive at the point where the American housewife would quit displaying gratitude to Mr. Frigidaire for his wonderful invention. ▲▲

# COMFORT HEATING COSTS LESS FOR C & M ENVELOPE CO.

Modern 460' x 200' plant of the C & M Envelope Co.
**Architects:** Nathan Siegler & Son, Newark
**Builder:** Lawrence Construction Co., Springfield, New Jersey



Model 125 Panelbloc as installed at C & M Envelope Co.

Panelbloc Heaters use natural, manufactured, mixed or LP gas as fuel

C & M Envelope Co. required a better than average heating system for their new Jersey City, N. J. plant. Even temperatures throughout and dust-free conditions were particularly important. The job was complicated by the fact that different temperatures were required for different areas: 70° in the working areas and 55 or 60° in the storage areas. Equipment and operating cost were also important considerations.

PANELBLOC Gas-Fired Infra-Red Heating was specified as the ideal solution to the problem. Each of the PANELBLOCS installed is equipped with its own thermostat, resulting in 57 separate, individually controlled temperature zones. Extremely even heating results. There are no fans or blowers, so the dust problem is eliminated. With no electrical connections, initial cost is cut and a power failure has no affect on the heating. With no moving parts, there is nothing to wear out. Overhead PANELBLOC takes up no valuable floor space. On mild, humid days, paper "curling" has been eliminated by turning on a heater or two in the area. The 57 PANELBLOCS bathe the 92,000 square feet of the new C & M plant in healthful sunlike warmth.

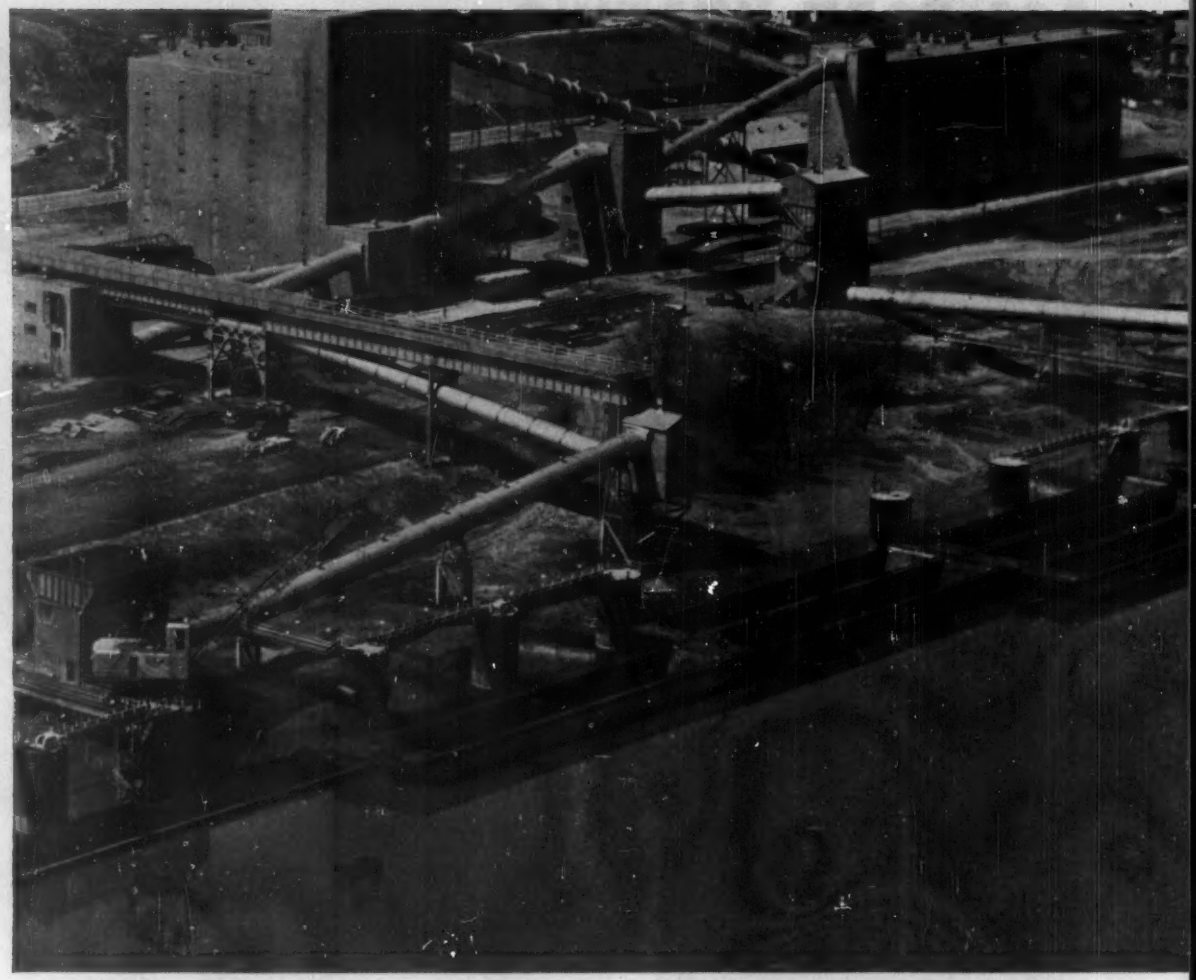
*Infra-Red Panelbloc HEATS LIKE THE SUN*

Approved by A.G.A., Underwriters, C.G.A.

**Write today for your copy of Bulletin PE2-61 "Application of Panelbloc Infra-Red Heating." A complete, easy-to-read "How to do it" booklet to help you plan Infra-Red heating for any kind of structure, in any climate.**

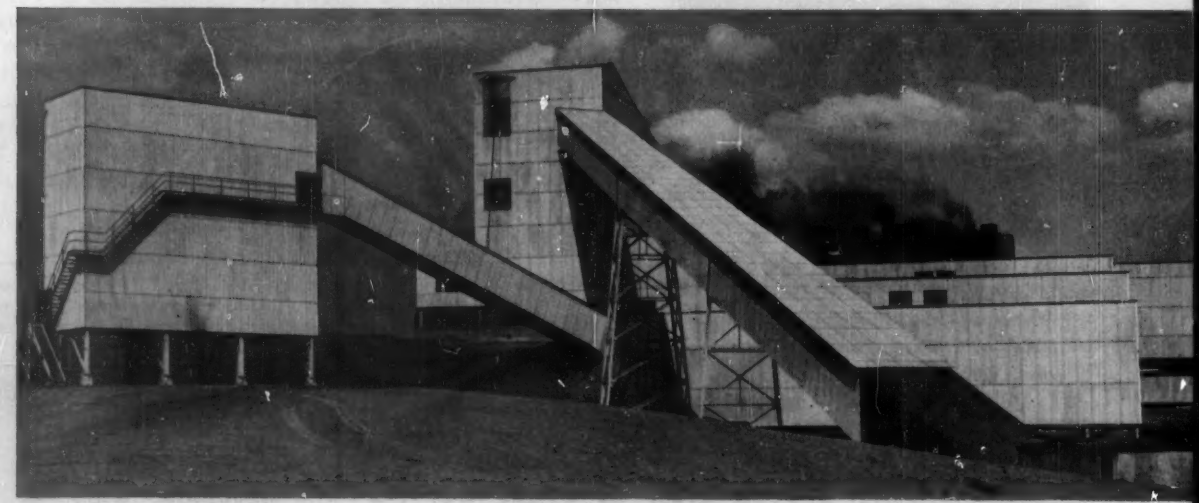
## PANELBLOC DIVISION

THE BETTCHER MANUFACTURING CORP.
**3106 West 61 Street DEPT. C Cleveland, Ohio**



**U. S. STEEL CORPORATION'S** Maple Creek Preparation Plant, New Eagle Boro, Pa., an A & G design, features the most modern concepts in coal preparation plant design with 800 tph raw coal capacity and 8,000 ton raw coal blending bin. Barber-Greene conveyor components supplied include idlers for the three 48" wide belt conveyors.

**HANNA COAL CO.** preparation plant, Cadiz, Ohio, was largest domestic washery at time of construction. Allen & Garcia Co., designed, engineered and constructed entire plant with 1,500 tph raw coal capacity. A total of 1,379 Barber-Greene idlers were specified for the conveyor systems that move coal through this large preparation plant.



# ALLEN & GARCIA COMPANY 30-YEAR CUSTOMER FOR BARBER-GREENE CONVEYORS

Allen & Garcia Company, consulting and constructing engineers, Chicago, has selected Barber-Greene belt conveyors and conveyor components on these and many other preparation and processing plants this firm has designed and erected in the past 30 years.

Use of Barber-Greene as a conveyor source for three decades by the 51-year-old Chicago firm is a result of client satisfaction with the products and of close cooperation between engineers of the two companies.

Actually, your firm can get far more than conveyor components with a world-wide reputation when you specify Barber-Greene. You can get the benefit of vast experience in designing and building conveyors systems for all industries with nearly every bulk material plus:

- A complete line of conveying equipment from the simplest to the most complex heavy-duty, high-capacity systems.
- Ability to determine the best solution to a materials handling problem, lay out the system, design and fabricate the required equipment, or to manufacture according to your design and specifications.
- Cost analyses for use in evaluating various systems and plant layouts and estimates or firm quotations on proposed equipment.
- Complete erection drawings, experienced supervision, or full responsibility for erection and start-up, whichever best suits you and your client's requirements.
- Service and repair parts immediately available through world-wide distributor network.
- A very special interest in and follow-through on your order to assure accurate fabrication and on-time shipment.

Count on Barber-Greene products and personnel to help you make the most favorable first and lasting impression on your clients. Your letter or telephone call puts Barber-Greene's 45 years of experience in the design and manufacture of materials handling systems to work for you and your clients.

MEMBER CEMA CONVEYOR EQUIPMENT MANUFACTURERS ASSOCIATION

*Products and personnel offering the ultimate in service*

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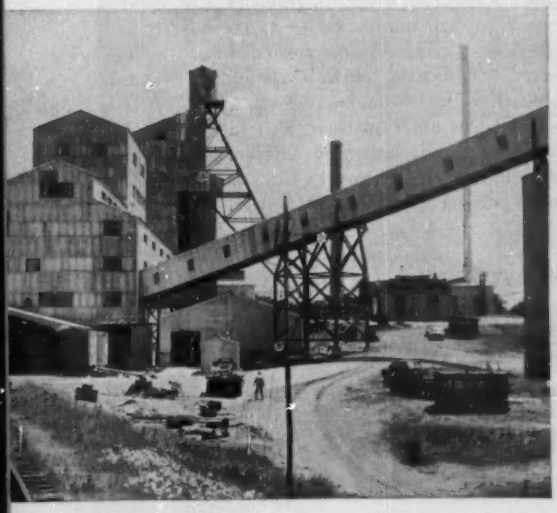
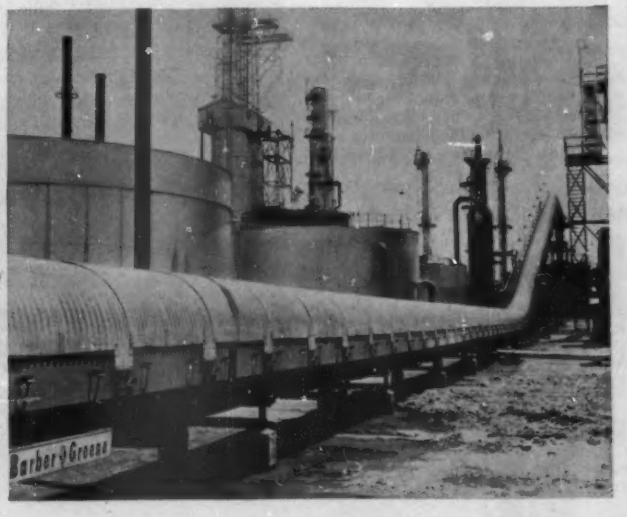
Other Plants: DeKalb, Milwaukee, Detroit, Canada, England, Brazil, Australia

**CONVEYORS • LOADERS • DITCHERS • ASPHALT PAVING EQUIPMENT**

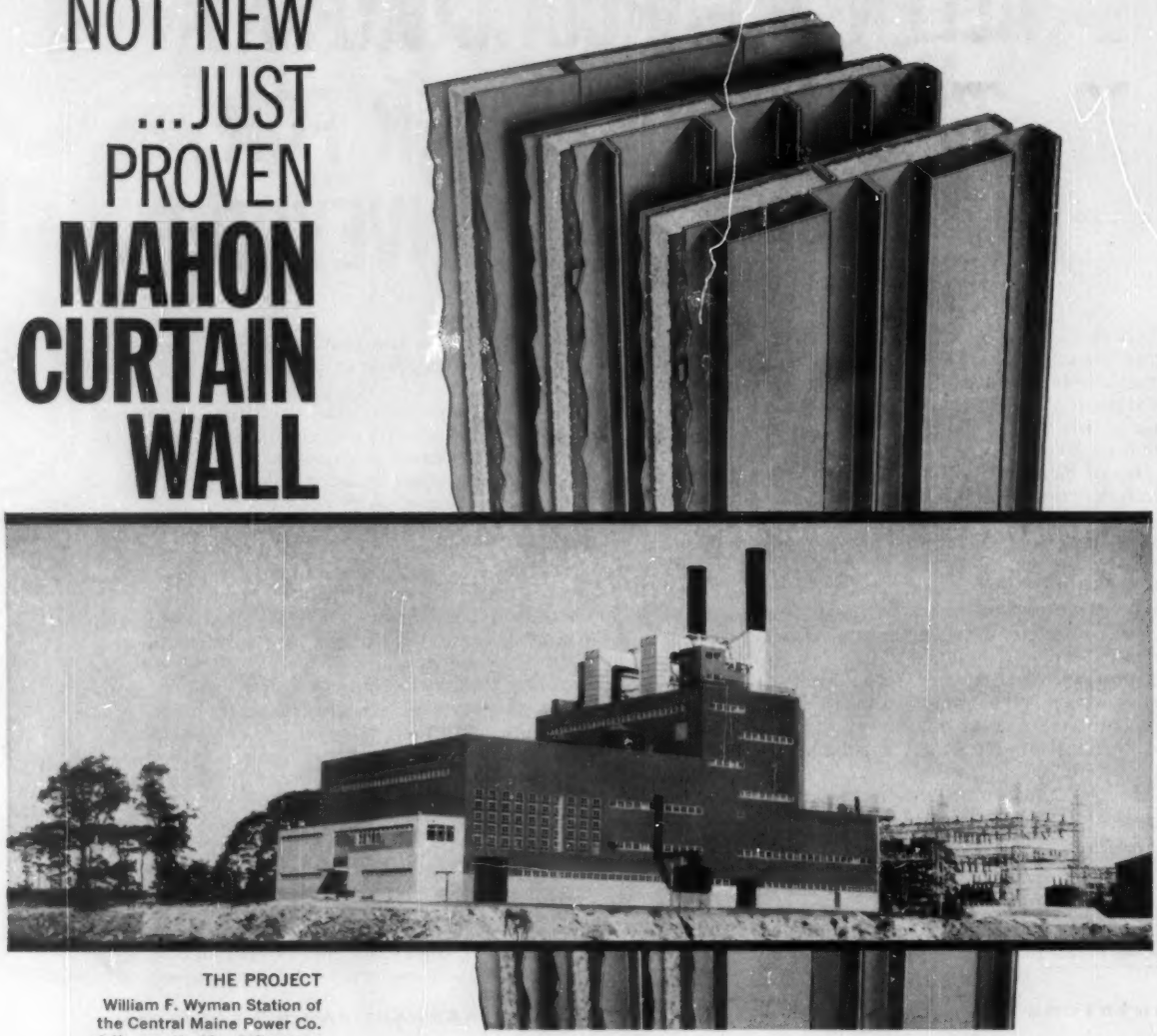
**DIAMOND CRYSTAL SALT CO.** plant expansion at Jefferson Island, La., A & G design, includes Barber-Greene idlers, terminal hardware and hinged stacker that stockpiled salt in mine.



**AMERICAN GILSONITE CO.** processing plant, Grand Junction, Colo. was designed by Allen & Garcia Co. with three Barber-Greene Belt conveyors, a radial stacker and a flight feeder as material handlers.



# NOT NEW ...JUST PROVEN **MAHON CURTAIN WALL**



**THE PROJECT**

William F. Wyman Station of the Central Maine Power Co. at Yarmouth, Me. A five-year old project that retains its bright-as-tomorrow good looks. Engineers: Jackson & Moreland, Inc. Gen'l Contractor: Sanders Const. Corp.

**THE SECTION**

Mahon's field-constructed (3-6-3) fluted pattern in green baked-enamel 16-gage galvanized steel with Fiberglas insulation (shown in foreground of three-section photograph). Erection by Mahon.

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Aluminum or Steel Curtain Wall • Rolling Steel Doors (Standard or Underwriters' labeled) • Fire Walls (Underwriters' rated) • M-Floors (Steel Cellular Sub-Floors) • Long Span M-Deck (Cellular or Open Beam) • Steel Roof Deck • Acoustical and Troffer Forms • Acoustical Metal Walls, Partitions, and Roof Deck

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Structural Steel—Fabrication and Erection • Steel Fabrication—Weldments • Geodesic Domes—Fabrication and Erection

Mahon Insulated-Metal Walls form a highly efficient wall system that is a far cry from flimsy 'low cost wall wraps'. When structural function, clean good looks, ease of erection and minimum maintenance are wall consideration, investigate Mahon. Available in various metals, diverse sections, different finishes, and a rainbow of colors to offer unlimited architectural-design freedom. What's more, Mahon Insulated-Metal Walls are quality-made, corrosion and fire-resistant, invisibly joined, easily sealed and are kept clean by rain showers. They mean true economy and lasting advantages. Write for informative Wall Catalog W-61, see Sweet's Files, or contact your local Mahon Building Products representative.

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MANUFACTURING PLANTS—
Detroit, Michigan and Torrance, California
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REPRESENTATIVES IN ALL PRINCIPAL CITIES.

SPEEDING AMERICAN CONSTRUCTION WITH METAL BUILDING PRODUCTS, FABRICATED EQUIPMENT AND ERECTION SERVICES.

# MAHON

CONSULTING ENGINEER

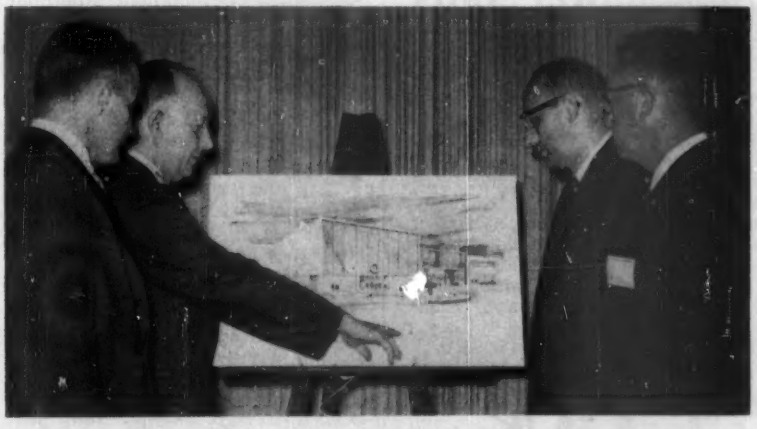
# CEC's Fall Meeting At Miami Beach

*Florida's Russell Raine, FACE President, greets California's Harold King, CEC President, with a cross-continent handshake. Observers from the presidents' kitchen cabinets are Wynelle Raine and Anne King.*

THE CAMEL is reported to be the ugliest of all beasts, and the only one created by a committee. Since every committee splits into at least two factions, it is not at all surprising to find some camels with one hump and others with two. If there is any truth to these bits of apocrypha, the Consulting Engineers Council, with its numerous committees, should be able to field the biggest caravan that ever trod the sands of the Sahara. However, based on evidence presented at the Council's fifth semiannual board of directors meeting last month in Miami Beach, there is good reason to believe that some committees can be both creative and effective.

### Insurance and the Law

One of the finest pieces of committee work was done by the group handling the subject of professional insurance, under the chairmanship of Lester L. Bosch. The formal report of this committee was probably the most complete of all that were presented. Unfortunately, appended to this report was a camelish hump in the form of a rather highly promotional piece of sales literature liberally sprinkled with the CEC stamp of approval. A motion to limit the circulation of this brochure was passed and then later quashed on the basis of the fact that NSPE and AIA publish similar material. The casual inference from this action is that three camels are prettier than two.



*Jerry Wyble and Gib Wilson, CEC members from the District of Columbia, discuss the proposed CEC building with Larry Spiller and Harold King.*

As an offshoot of the professional insurance committee's activities, CEC received a proposal that it retain top-notch legal talent for the handling of member firms' court cases arising out of professional liability claims. This is an extremely fortuitous suggestion, and it matches perfectly with the efforts of George Heft, who has recently accepted chairmanship of the legal committee. The function of this committee is to investigate legal problems which are national in scope and therefore of interest to all member firms in Consulting Engineers Council. In terms of CEC's annual budget, the cost of such activity is fantastic. However, the fact that a plan has been advanced for CEC

# PREVENT BUILDING BLACKOUT

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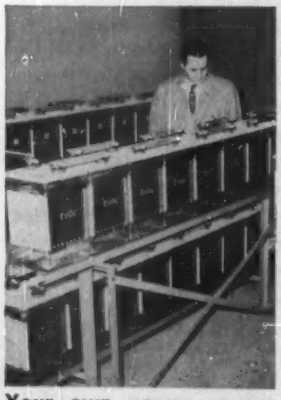

**Your own power source.** High-capacity Exide batteries handle lighting loads for entire buildings. Last as long as 25-30 years. Automatic chargers keep them full charged, always ready.

An Exide Emergency Lighting System belongs in the plans of every modern building. It's low cost protection against panic, damage, theft and injury. Can save thousands of dollars in only a few minutes of use. When regular electricity fails, Exide power takes over and keeps lights on—instantly and automatically. Exide provides systems to suit any size building—store, office, hospital, etc. Recommends either lead-acid or nickel-alkaline batteries, depending on your requirements. For details, write Exide Industrial Marketing Division, The Electric Storage Battery Company, Philadelphia 20, Pa.

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to retain legal counsel is an effort in the right direction, and Heft's committee probably will get a few thousand dollars to work with in the coming year. It is hoped that the ante can be raised to about $10,000 the following year, and there is general recognition that even this is only a beginning.

### Indexing

Perhaps because it did not ask for any money, Robert W. LaTour's engineers' catalog indexing system committee did not seem to get the attention it deserved. Nothing could advance the engineering profession in general, and private practice in particular, faster than the elimination of the ubiquitous and frequently inappropriate AIA File Number on manufacturers' product literature. This little public relations gambit on the part of the architects has served them well, and will continue to keep the engineer in No. 2 position until he can come up with something better — or equal. An engineer's file number on appropriate literature should be an important CEC goal.

### Foreign Aid Developments

One of the highlights of the Miami Beach meeting was the appearance of Robert L. Moorman, Chief engineer, Development Loan Fund. Speaking about the Kennedy Administration's new Agency for International Development, Moorman pointed out that the United States foreign aid program has been reorganized five times since the original Marshall Plan. In Moorman's opinion, AID offers the last chance for the United States to establish a successful foreign aid program. He called on consulting engineers to display enough statesmanship to sacrifice some of their top men for the important engineering management positions which will soon be open in AID.

Moorman pointed out that successful foreign aid programs are highly dependent upon the technical and ethical competence of engi-

# WEINMAN PUMPS
## give Florida Bank Building
# PERFECT WEATHER
## in every office

One of the South's most modern banking facilities, The First National Bank of Orlando, features functional design in brick, glass and marble with dramatic horizontal and vertical lines. Architect: Kemp, Bunch and Jackson, Jacksonville, Fla.; Consulting Engineer: VanWagenen, Taylor and VanWagenen, Jacksonville; General Contractor: Sipple, Thompson and Street, Orlando, Fla., and Mechanical Contractor: Wrenn Brothers, Rock Hill, South Carolina.

Like many another user, officials of The First National Bank of Orlando have found Weinman Pumps exceed requirements for efficient, economical, low-maintenance pumping. To solve *your* pumping problem, call your Weinman Centrifugal Specialist today . . . he's in the Yellow Pages. Or, if you prefer, write us direct.

The First National Bank Building, with its blank north and south walls, provides downtown Orlando, Florida, with a striking new landmark. Bank facilities occupy the first four stories of the 160,000 square foot structure. The other eight floors provide modern, spacious quarters for many of Orlando's business and professional people.

And . . . in Florida . . . air conditioning is important. That's why the First National Bank of Orlando depends on a 2-unit, 550-ton Carrier Hydronic System to give the bank perfect year 'round climate no matter what the weather is outside. And, that's why each Carrier unit relies on a Weinman Pump for instant and efficient circulation of chilled (45°F.) or hot water throughout the system. A Weinman Pump also delivers chilled water to the primary air fan for precision control of humidity at 55°F. Still another Weinman Pump (with standby) circulates water continuously through the system's chill water loop.

And, other offices in the First National Building get the same ideal climate from one of 389 Carrier modular, under-window units that permit individual offices to "dial" the weather they want without effecting any other office. Two Weinman Pumps deliver hot or chilled water instantly to each of these units upon demand.

In addition, two Weinman Duplex Condensate Return Units provide the First National Bank Building with fast, efficient steam condensate return and a Weinman Non-Clog Type Pump removes sanitary waste and basement seepage.

Note the neat installations of some of the 12 Weinman Pumps used for circulating hot and chilled water through the 12 story building's air conditioning system.

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neers in private practice. Thus, it is incumbent on the profession to provide adequate engineering management to insure that the foreign aid programs are carefully conceived and adequately executed. Recent rumblings from within ICA are warning enough that all is not going well on our foreign aid program in those areas involving the construction industry.

While the new head of AID was just appointed on September 30, no time can be lost in getting the program under way. As its contribution to the new program, Moorman suggested that CEC should be prepared to establish a list of general qualifications which would help administrators of AID in their evaluation of consulting engineering firms seeking overseas work. For example, one of the biggest problems with consulting engineer firms seeking overseas work is their tendency to take on jobs with a dollar value far beyond their capabilities. In spite of its technical competence on small projects, a small firm is almost certain to get into trouble when it overreaches itself.

G-A CUSHIONED FLOWTROL VALVE

It's easier to operate a G-A Flowtrol Valve than it is to drive a car with power steering! The reason? Line pressure furnishes the power to open or close the valves. No manual effort, no handwheels, no motors, no levers are needed—regardless of size of valve or pressure. Just a "flick of the wrist" or press of a button will fully open or tightly close the valve.

Get all the facts in Bulletins W-8A and G-4.

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### Principles and Performance

One of CEC's finest efforts was the development of a Manual of Principles and Performance by Thomas R. Miles' committee, back in 1960. In fact, had some of the members of the board of directors at Miami Beach read it carefully before coming to the semiannual meeting, they would have saved a considerable amount of useless debate.

One of the important additions to this volume is a section on mechanical-electrical special conditions. Copies of this important document were presented at the meeting and are now available for general use. It is expected that they will receive the same wide acceptance by both consulting engineers and contractors that was received by the documents currently in use.

### Deliberation and Discussion

One of the interesting variations at this year's semiannual meeting was the assignment of three full working days for board deliberation. After two solid days of committee reports and discussion, the program was broken up by the introduction of a morning seminar program. The moderators included Bengt Friberg, Harry Czyzewski, James DeSerio, and Frank Kulas. Topics ranged from professional associations to joint ventures, and although the moderators and their panels did an excellent job of meeting the established time schedules, it was simply a case of too much material and too little time. Next year's program committee might consider the advisability of maintaining the three-day meeting schedule, with a single panel scheduled for some critical point on each of the three days. Certainly, a good panel discussion combined with some spirited comments and questions from the floor can do much to break up what is

*The Oklahoma Test Road north of Oklahoma City will eventually be part of Interstate route 35*

# concrete wins on Oklahoma Test Road with maintenance cost 65% lower than asphalt!

**5-year traffic test, ordered by the Oklahoma legislature, confirms again the findings of state highway departments and other official tests.** Connecting two-mile sections of concrete and of asphalt, both the best of their type, were built in 1955 on Oklahoma's US 77. For five years beginning Jan. 1, 1956, exact records were kept of all *pavement* maintenance costs. Total for concrete: $557.82. For asphalt: $1,591.87. And not only did the asphalt cost nearly 3 times as much to maintain during the five years—it is already getting its first resurfacing at an additional cost of $43,753.

Substantial maintenance economy is one reason why concrete is the choice of so many states today. Engineers are designing concrete pavements to last 50 years and more. It's the one pavement that can be designed *mathematically* to meet specific wheel load requirements. It's the only pavement with beam strength and stability.

The Oklahoma Test Road proves again the long-term value of concrete pavements. The first cost isn't just a down payment. Concrete provides true economy for Interstate highways as well as for other heavy-duty roads.

**Complete resurfacing after only five years adds another $43,753 to asphalt's upkeep!**

Despite continued surface maintenance for five years, the asphalt pavement on the Oklahoma Test Road has deteriorated to the point where complete resurfacing is required. The asphalt sections are being overlaid with 1½ inches of surfacing to seal out moisture and provide a new wearing course. When comparison is made, as shown here, on the basis of *total upkeep* cost, concrete's advantage is dramatic.

| CONCRETE | |
|---|---|
| 5-year surface maintenance | $557.82 |
| total surface upkeep | $557.82 |

| ASPHALT | |
|---|---|
| 5-year surface maintenance | $1,591.87 |
| complete resurfacing | $43,753.00 |
| total surface upkeep | $45,344.87 |

**PORTLAND CEMENT ASSOCIATION**

*A national organization to improve and extend the uses of concrete*

*In executive session at the Golden Gate are Harold King, George Toman, Ced Acheson, San Fosholt, Hueston Smith, and George Foulsen. Officers met prior to start of board meeting.*

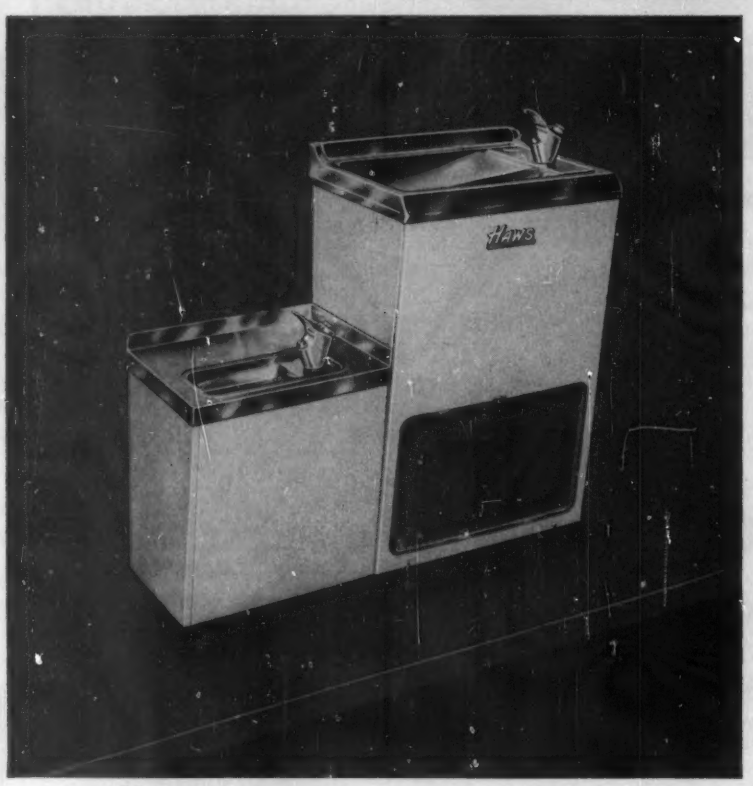
often a monotonous recital of things past and things yet to be.

For those CEC associations pressing for a Washington headquarters, the executive committee had an encouraging word. Indications are that a new managing director will be hired shortly, and that the offices of CEC soon will be located in Washington, if only in temporary quarters. Meanwhile, considerable encouragement has been given to the District of Columbia group which is interested in building a CEC headquarters.

**Amenities and Advice**

The Florida Association, and particularly Robert Jaffer, are to be commended for an excellent job of hosting the 1961 fall meeting. Facilities at the Golden Gate Motel were generally rated excellent — except for the air conditioning, which was too cold for thin blooded Northerners. However, adequate warmth was provided at the annual convention banquet by Richard Wagner, President of the U. S. Chamber of Commerce.

A final word of advice to next year's meeting planners: fewer committee reports and a better balance between topics of interest to the stronger and the weaker member associations. And, above all, CEC should act like a strong national organization by retaining adequate public relations counsel to get its significant debates in the local press — and possibly the national wire services. ▲▲

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**THE HAWS HI-LO,** with convenient bubblers at both child and adult levels, combines an off-the-floor cooler with low level fountain attachment, serving all ages. Stainless steel tops on Cool Mist Gray baked enamel steel cabinets. Various capacities available.

*Write for detailed specifications and copy of Haws Catalog.*

Since 1909 HAWS · ELECTRIC WATER COOLERS

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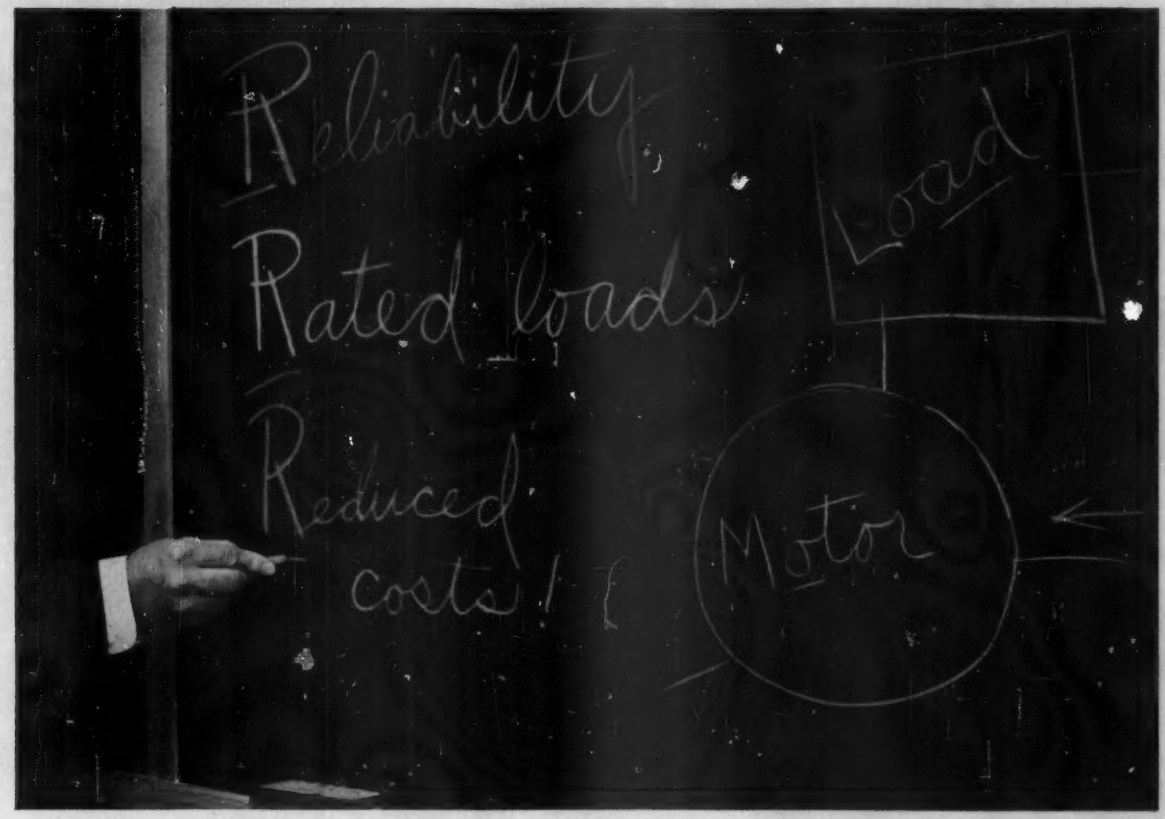
**SILICONE NEWS from Dow Corning**

# Consider these 3 R's...




## ...and you'll specify silicone insulated motors!

Electric motors, properly applied, are about as reliable as any rotating equipment can be. But what does "properly applied" mean? Do the newer motor insulation systems modify long accepted application practices? If so, how? What about reliability? Rated loads? And that old bug-a-boo, costs?

***Reliability*** depends on where a motor is located and what kind of job it's doing. High ambient temperatures and the heat of overloads are handled easily by the high thermal stability of silicone insulation. Fly ash and other airborne contaminants bounce off sealed silicone rubber insulation systems without degrading reliability. Humidity and moisture are taken in stride by coils that have been high potted under water as a production check.

***Rated load*** of driven equipment is frequently the maximum load a motor ever will be called on to deliver. Specifying motors with nameplate horsepower rated for short-term, peak load conditions is being outmoded as too expensive. Today, it's far more economical . . . and just as reliable . . . to specify silicone insulated extra service factor motors with horsepower rating based on nominal load conditions. Additional horsepower output — up to 50 percent above nameplate rating — is available for peak loads because of the excellent thermal stability of silicone insulation.

***Reduced costs*** result from specifying extra service factor motors. Further savings . . . up to 30 percent of initial costs . . . result from specifying open motors with sealed silicone rubber insulation systems instead of motors with elaborate enclosures.

If you have not investigated Dow Corning silicone insulation systems, why not take advantage of the free literature offer below?

"Specify Silicone Insulation . . . and Save" is yours for the asking. Write Dept. 3024, Dow Corning Corporation, Midland, Michigan.

first in silicones

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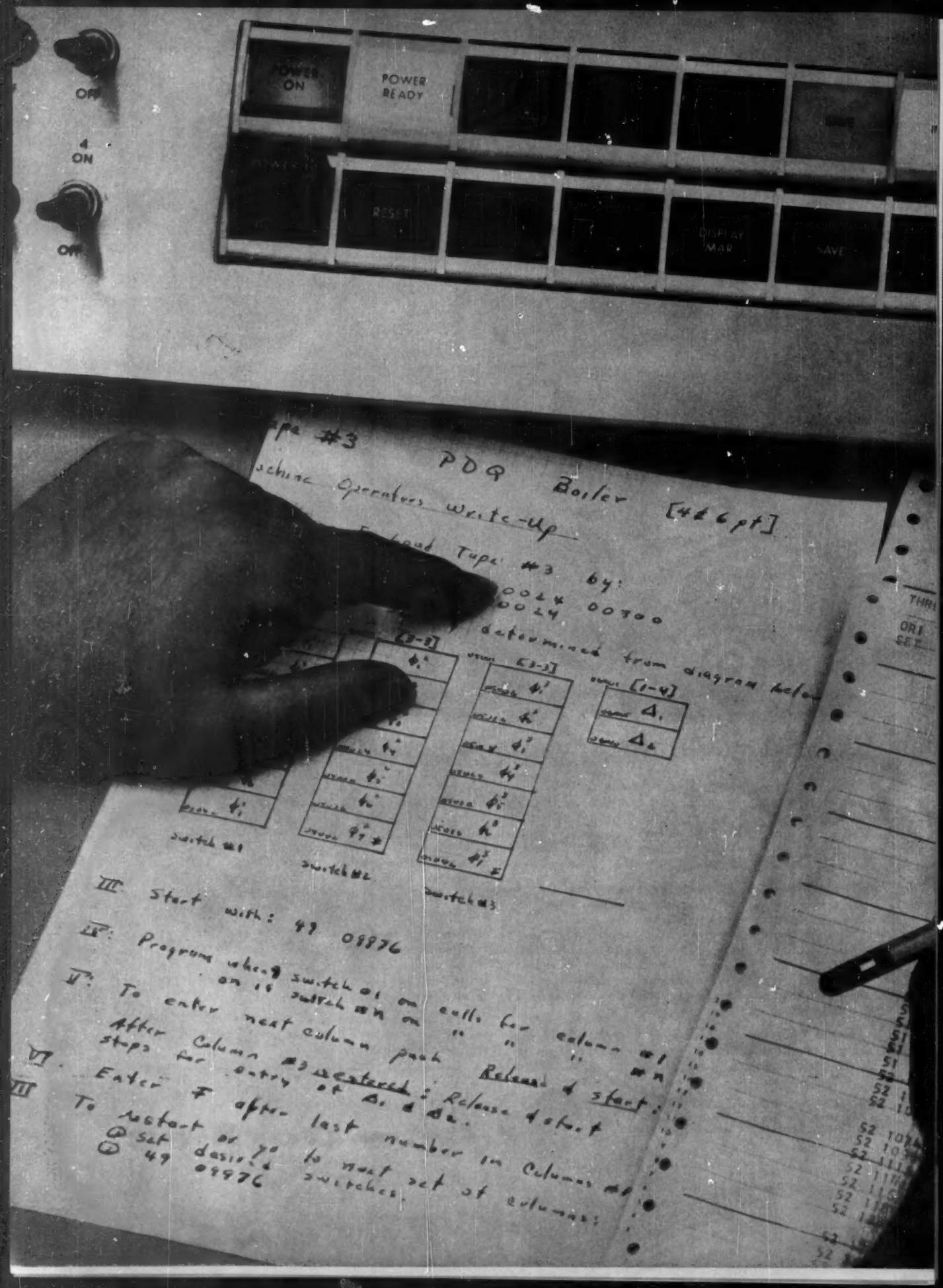
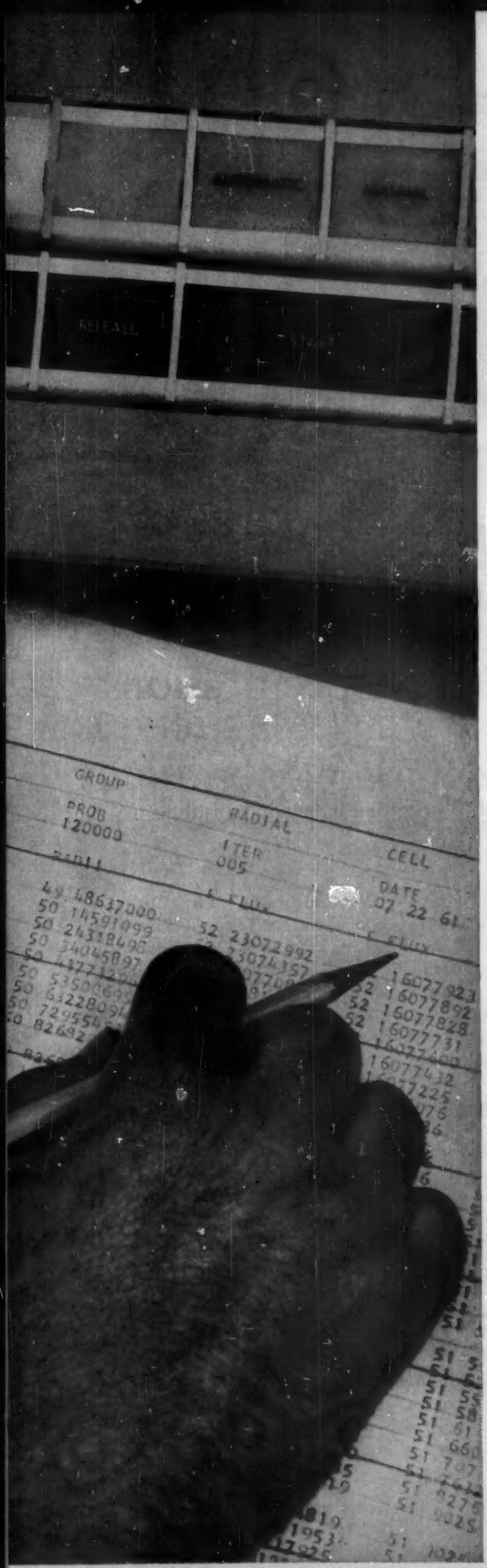

POWER ON
POWER READY
RESET
DISPLAY MAR
SAVE
OFF
4
ON
OFF
PDQ Boiler [4 & 6 pt]
Load Tape #3 by:
00424 00900
00424
determined from diagram below
switch #1
switch #2
switch #3
III Start with: 49 09876
IV Programs when switch #1 on calls for column #1
on if switch #n on " " " #n
V To enter next column push Release & start.
After Column #3 entered: Release & start
steps for entry of Δ1 & Δ2.
VI Enter F after last number in Columns #1
To restart or go to next set of columns:
① Set desired
② 49 09876 switches.




# Cost of one-dimensional criticality computations drops from an average of $75.00 to $7.50 per problem

Faster computing, less travel time are the reasons why General Nuclear Engineering Corporation has realized such cost savings since it installed an IBM 1620 Data Processing System at its Dunedin, Florida plant.

Since its main computing facilities are not located at Dunedin, General Nuclear has found that the new 1620 eliminates much of the travel time and expense involved in taking problems to off-site computers. In addition, the 1620 performs the simpler criticality computations 10 times faster than the computer previously used at one of General Nuclear's off-site data processing centers.

General Nuclear uses its new 1620 for other problems, too...heat transfer calculations, various transient codes, mathematical routines for the physics and engineering departments, multi-group calculations, and many other jobs you might expect only a much more expensive computer to be able to handle.

This isn't all. General Nuclear uses the 1620 to do statistical analyses and variance calculations on input data for programs run on off-site large-scale IBM computers.

For information on this highly versatile, low-cost data processing system, which rents for as little as $1600 a month, contact your local IBM Representative.

Easy to program. FORTRAN, IBM's scientific computer language is available for the 1620. General Nuclear scientists use a special scientific interpretive program—FIDO—written by the Manager of their Computing Section.

IBM®
DATA PROCESSING

**FACTS** *to simplify water supply planning*

**BULLETIN B-1400 has many helpful tips to help you select and specify SUMO SUBMERSIBLES for municipal and industrial water supply and in-line booster pump service. Included are construction details and performance data. 3550 and 1750 rpm models.**

**Send for your FREE copy today!**

**SUMO PUMPS INC.** | **Brown House Rd. Stamford, Conn.**

**COMPLETE SERVICE**

- **Design**
- **Construction**
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**STEBBINS ENGINEERING AND MANUFACTURING CO.**
**Watertown, N. Y.**
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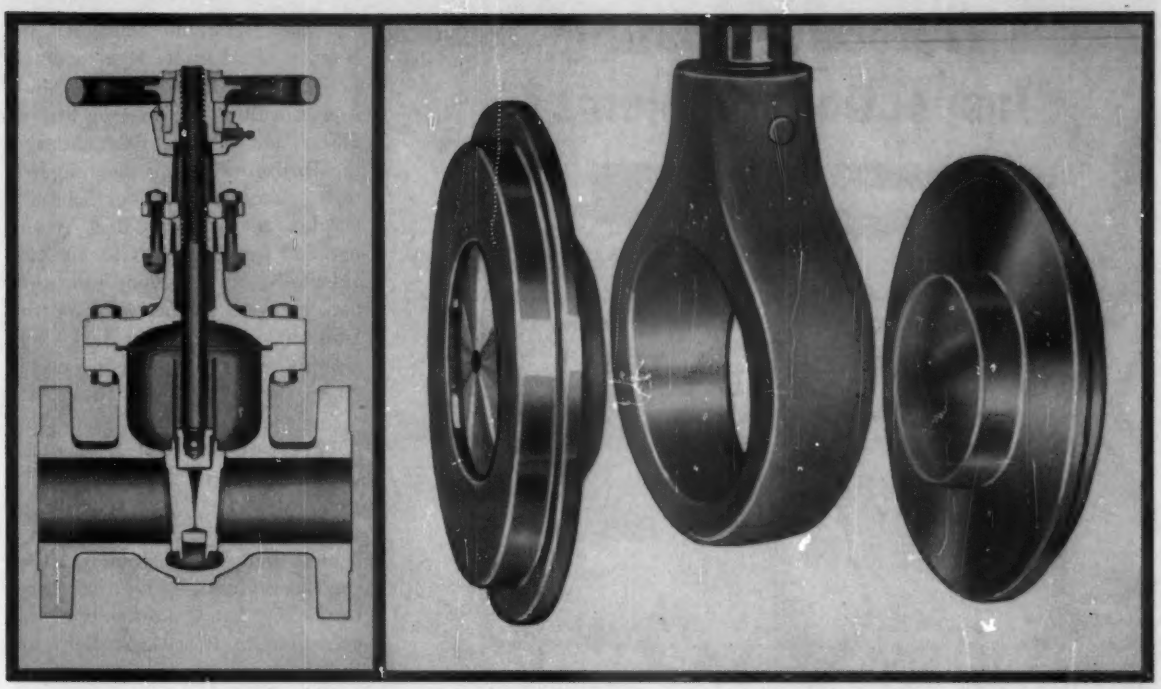
*Speakers at the University of Wisconsin-CSI Engineering Institute included Harold L. Olson, Glenn G. Frazier, Robert G. Burkhardt, Edward O. Busby (Institute Coordinator from the University), Robert P. Jaffer, and R. Robert Lydon.*

# Preparing Construction Contracts and Specifications

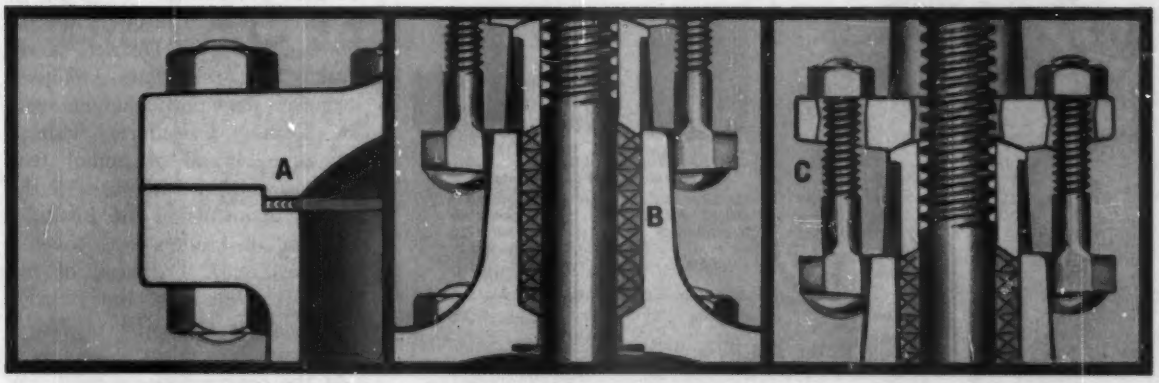
A University of Wisconsin Engineering Institute

"PREPARING Construction Contracts and Specifications" was the subject of the latest University of Wisconsin Engineering Institute, at Madison, on October 19 and 20. Planned in cooperation with the Construction Specifications Institute, this session brought together a mixture of consulting engineers, contractors, architects, building materials salesmen, city officials, and a few plant engineers. Unofficially, some of the speakers apparently had decided that it was open season on contractors, but the general tone of the meeting was amicable.

The official sessions were opened by Robert G. Burkhardt, Chicago consulting engineer. He was followed by Glenn G. Frazier, Urbana, Illinois, architect; and Robert P. Jaffer, from the consulting firm of Beeman, Britt, Curley & Jaffer, Inc., in Tampa. Frazier gave a rundown of the revisions in the AIA General Conditions, pointing out that a goodly number of the changes were made to clarify the responsibility and authority of the contractor. Jaffer pointed out the fact that the Consulting Engineers Council Conditions of Contract required a greater breadth of coverage because they are applicable to many types of projects other than buildings. He also pointed out the advantages of the CEC documents from the standpoint of easy reference through the classification of material under broad subject headings. In closing, Jaffer made the specific recommendation that specification writers clearly understand standard documents



# New 300 & 600-Pounders extend Crane line of stainless steel gate valves. Feature unique, free rotating, split-wedge disc.




The unique Crane split-wedge disc design features two identical disc halves, fitted back to back in a carrier that is fastened to the valve stem. The moment the lower portions of the disc halves contact the seats, the carrier exerts uniform pressure on the beveled sides of both disc trunnions, forcing the disc halves outward against the seats. This results in a perfect seal and long trouble-free valve life. Free rotation of disc halves prevents wear and galling, keeps seat faces clean.

Other quality features include **(A) Recessed, spiral wound bonnet gasket** which permits face to face abutment of body and bonnet flange. Provides predetermined gasket loading. **(B) Extra deep stuffing box** for tightness and long life. **(C) Thru stud-bolts** for easy upper valve servicing.

There's a wide choice of Crane Stainless Steel Gate Valves in 18-8 SMo or CRANELOY 20 in 150, 300 and 600 Pound Classes with screwed or flanged ends, temperatures up to 800 F. (300 & 600 Pound) . . . up to 500 F. (150 Pound).

For complete details contact your Crane Distributor. Or write to Crane Co., Dept. U, Industrial Products Group, 4100 South Kedzie Ave., Chicago 32, Illinois. In Canada: Crane Ltd., 1170 Beaver Hall Square, Montreal.

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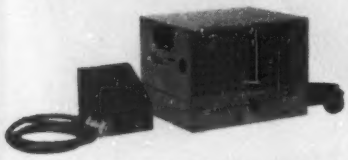
VALVES AND PIPING
ELECTRONIC CONTROLS
PLUMBING
HEATING - AIR CONDITIONING

# Protective Coating Inspection Problems?

**Here's Your Answer**

No matter whether you're coating a pipeline or a chemical tank, continuity is vital. Use of a Tinker and Rasor Holiday Detector while the job is open, can save days of downtime later on.

**• PLANT AND YARDS**



**Tinker and Rasor**
**EPAC Holiday Detector or J-1ACM**

EPAC operates off 110 volts A.C. power for stationary coating operations. Internal voltage adjustment from 5,000 to 20,000 volts or with external variable transformer from 500 to 6,000 volts, or 5 KV to 20 KV.

J-1ACM for continuous inspection on coating and wrapping machines which use water for cooling.

**• PIPE**

**Tinker and Rasor**
**E-P or E-4 Holiday Detectors**

Output adjustable from 5,000 to 20,000 pulsating voltage.

E-P—All purpose for larger diameter pipe, damp or dry climate, pre-fab film or hot applied coatings.

E-4—Lower cost, dry surface type of detector specifically designed for smaller diameter pipe and flat surfaces.

**• THIN FILM**

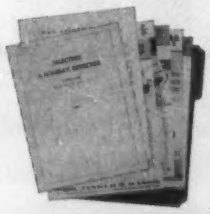
**Tinker and Rasor**
**M-1 Holiday Detector**

For painted or sprayed thin film coatings such as vinyls and epoxies. Maximum applied voltage 67½ V., non-destructive to coatings. Belt mounted, 4-lbs. total weight.

**• UNDERGROUND**

**Tinker and Rasor**
**Pearson-type Holiday Detector**

For detecting holidays and electrical shorts without uncovering the pipeline. Completely transistorized . . . generates 15 watt, 750 cycle, stable A.C. Audio-frequency signal. Adaptable to null search method.



Tinker and Rasor has prepared a complete data kit which describes the null search system as well as other recommended procedures for inspecting protective coatings. Material includes technical data on equipment, general discussion of types of detectors, theory of operations, etc.

**Engineering Note:**
To insure a perfect application, include Tinker and Rasor Holiday Inspection. Write for specification guide.

*Quality Control for Coating Application*

**TINKER & RASOR**

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and then seek the additional insurance of adequate legal counsel.

Harold L. Olsen, from the Madison consulting engineering firm of Olsen and Evans, toastmastered the Institute's dinner meeting featuring James C. Bort, of Schmidt, Garden & Erickson. Bort is the national president of CSI and, incidentally, an excellent after-dinner speaker. In his talk on the aims and objectives of CSI, Bort cleared up some misconceptions which seemed to be bothering many consulting engineers. Bort pointed out that CSI has no intention of turning out a set of standard specs which will be all things to all people. He also made it clear that he does not feel that specification writing is "a new profession." What CSI intends to do, according to Bort, is to help the specification writer determine what it is that he should write and how he should write it. CSI has but one goal: a clear and concise set of specifications.

Other talks presented at the Institute included one on contract documents as they apply to the Federal government, given by R. Robert Lyden, Chief of Specifications, 9th Naval District. Karel Yasko, Wisconsin State Architect, disguised some pertinent comments on bidding procedures with a homespun brand of humor that revived a tiring audience in the waning moments of the Institute. Bonding of bidders was covered by Warren H. Fuerman, of the Milwaukee office of the Fidelity and Deposit Company of Maryland, and the subject of insurance and the construction contract was covered by O. J. Rudser, of Employers Mutual of Wausau.

Edward O. Busby, Institute Coordinator, is to be congratulated on another successful University of Wisconsin Engineering Institute. He has made plans to send copies of all papers to the Institute participants and interested readers may obtain copies by writing CONSULTING ENGINEER magazine ▲▲

# The best ears agree

## Hevi-Duty Dry-Type Transformers... so quiet you'll get no complaints

Schools, hospitals, motels, hotels... wherever quiet is the first order of business . . . you'll find Hevi-Duty dry-type transformers your smartest choice for installation.

Cores and coils are especially designed to give low decibel ratings. Moisture and corrosion-resistant polymerizing varnish is baked on in two separate operations. Besides giving excellent electrical protection, this results in substantially reduced noise levels. All laminations and components are bonded together tightly to cut vibrations.

Be sure you obtain these features. Specify Hevi-Duty transformers . . . or write the following into your specifications: Coil and cores "double-impregnated with polymerizing varnish."

For more information, write for Bulletins 100 and 200 or call your nearest Hevi-Duty sales office.

### Designed sound levels for typical Hevi-Duty dry-type transformers

| SINGLE-PHASE | | THREE-PHASE | |
|---|---|---|---|
| KVA | DECIBEL RATING | KVA | DECIBEL RATING |
| 1.0 | 33 | 6.0 | 38 |
| 7.5 | 33 | 9.0 | 40 |
| 10.0 | 40 | 15.0 | 44 |
| 20.0 | 44 | 30.0 | 43 |
| 37.5 | 44 | 45.0 | 45 |
| 75.0 | 45 | 112.5 | 45 |
| 100.0 | 45 | 150.0 | 45 |
| 167.0 | 45 | 225.0 | 50 |
| 250.0 | 50 | 300.0 | 50 |
| 500.0 | 52 | 500.0 | 53 |

Transformers up to 1000 KVA can be supplied with sound levels of 45 decibels.

**HEVI-DUTY**

Dry-Type Transformers
Constant Current Regulators

B P C

**HEVI-DUTY ELECTRIC COMPANY**
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*A Division of Basic Products Corporation*

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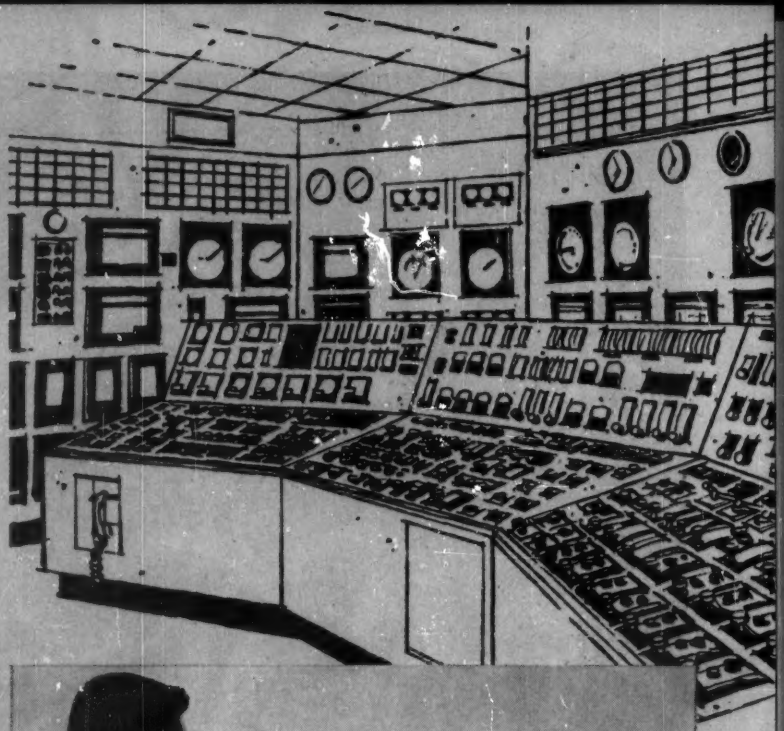


## FIRST SIMPLIFY...

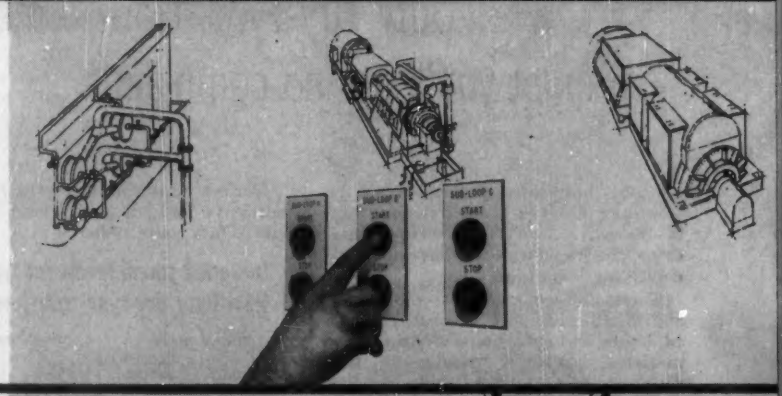
**First step** to automation is to *simplify* the information now presented by a multitude of multi-record charts, gages, and annunciator lights. The Bailey approach gives the operator data he needs (logged periodically), keeps continuous watch on all variables, makes calculations where required, alarms when trouble threatens.

Bailey 700 Systems draw on the best available techniques, including analog and digital manipulation, trend recording, time sharing, scanning, alarming, calculating, controlling, and logging, as required to meet operating objectives.

Reliability of recorded data is increased . . . operators can devote full attention to correcting off-normal conditions and improving operations. The system may include frequent performance calculations showing the contributions of each portion of the cycle to over-all performance so that faults and deterioration may be spotted and corrected.

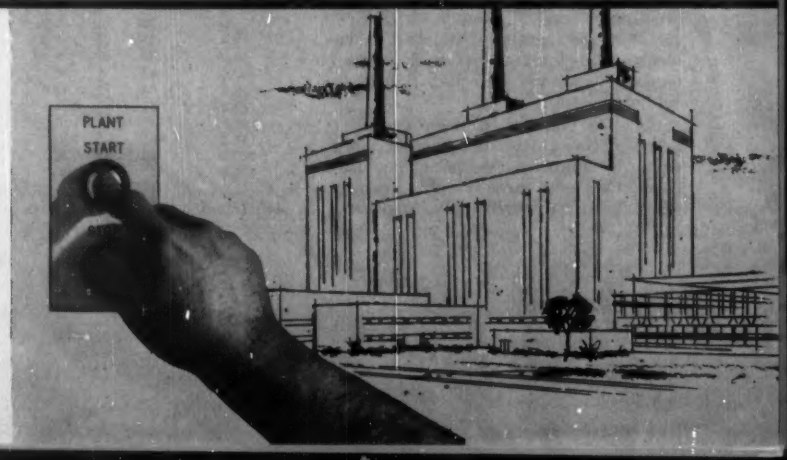
## NEXT VERIFY...

**Next verify** the practicability of automation by extending supervisory controls, letting equipment perform more operating functions. Automate key systems, one at a time, by push-button-controlled subloops. This approach smooths the transition to complete automation.



## THEN AUTOMATE

**Final steps are:** (1) consolidate supervisory controls, conventional controls, and subloops for full-range automatic operation once the plant has been placed on the line; and (2) add start-stop control to provide full automation.



# first Simplify...

## NEXT VERIFY...
## THEN AUTOMATE

### Bailey verified steps to automation mean benefits now... and increasing benefits as you go

Automation need not be an all-out commitment. Between today's conventional power-station control and the ultimate in automation are step-by-step advantages that can be gained—as individual problems are resolved.

This permits the final investment commitment only after satisfactory evidence that it is economically justified and practicable.

Bailey Systems concepts are embodied in the approach, "First simplify — next verify — then automate". The steps outlined here coordinate the best available techniques, including analog and digital, in Bailey 700 Systems designed — and expanded as desired — to the needs of the individual plant. They may be undertaken singly, in combination, or in entirety. System elements are composed of solid-state electronic modules providing the ultimate in reliability and flexibility.

Bailey 700 Systems are in operation today —or on order for installation—from coast to coast and all over the world. Ask your Bailey Engineer, or write for details. Bailey Meter Company, 1064 Ivanhoe Road, Cleveland 10, Ohio. In Canada — Bailey Meter Company Limited, Montreal.

*System concepts founded on 45 years of experience*

21 out of 26 of today's "most efficient" steam-electric stations in the United States use Bailey Instruments and Controls*. This reflects the more than 45 years of Bailey developments devoted to improving the reliability of power-plant operation. These developments include experience in automation, dating from electrically operated boiler controls in 1924 and automatic start of boiler controls on steam-electric locomotives in 1936, to systems installations in operation, or under construction today, from coast to coast and throughout the world.

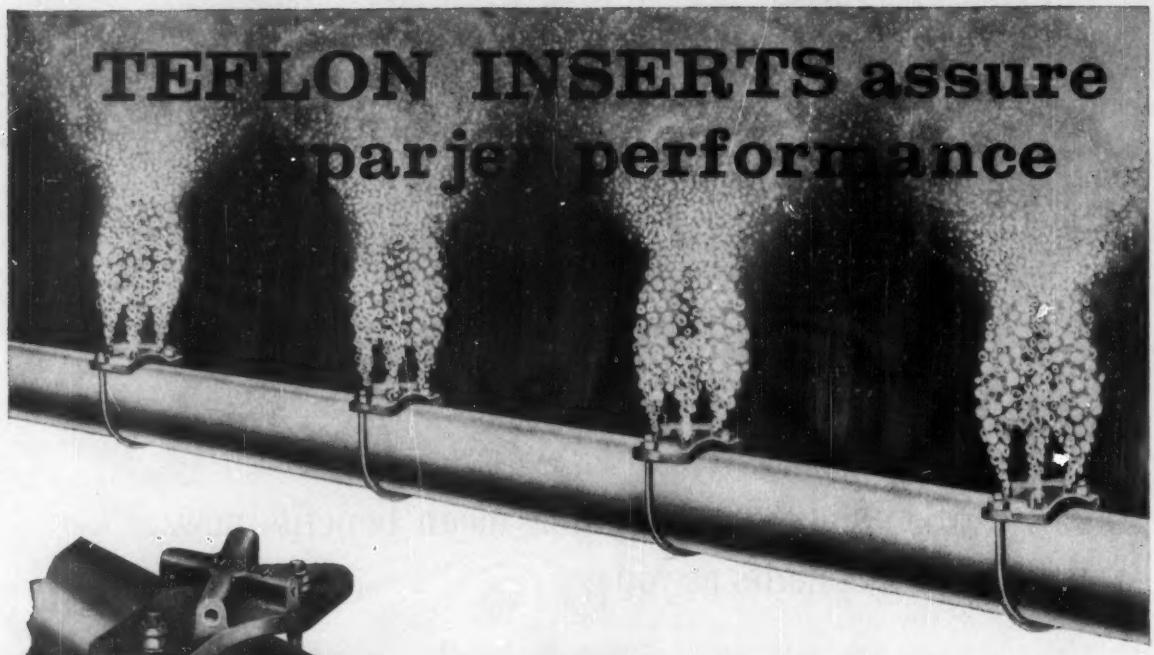
*Listed in Federal Power Commission Report S-143.

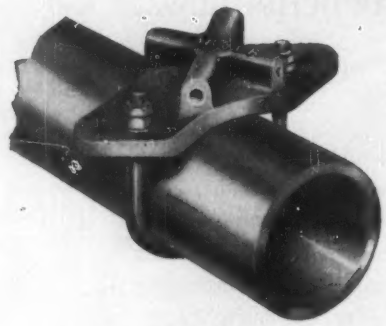
A 166-2

BAILEY METER COMPANY

700 Systems

# TEFLON INSERTS assure sparjer performance





**Repeating clusters of accurate Teflon orifices cause—**
**—sudden change in energy immediately above SPARJERS to produce small bubbles.**
**—exceptional air lift with greater tank "roll" and surface turbulence.**

Now—with Teflon inserts — SPARJERS offer more assurance that even infrequent plugging will not occur. Oxygenation efficiency remains constant, operation is simplified, maintenance is avoided and power costs are reduced. Where ordinary air diffusers are plagued with progressive plugging; actual plant experience, in hundreds of installations, has proven that SPARJERS most nearly approach clog-proof operation. Particles cannot cling to the exceedingly slick Teflon surface. Also, the electroplating phenomena, encountered when certain colloidal clays are present in the sewage, is avoided. SPARJERS, properly applied, give oxygen transfer efficiencies equal to diffuser tubes. No elaborate air filters required; utilizes inexpensive oil-wetted wire baffle-type unit. Operates trouble-free in all solids-in-liquids combinations—even in digesters charged with thickened sludges. More and more installations are replacing their tube diffusers with SPARJERS; and none have ever had to increase their air supply. Send for installation list.

*Walker Process also offers PLATE-TUBE diffusers for unusually low air release applications. JACK-KNIFE pivotal headers provide a convenient and economical method of installing SPARJERS or PLATE-TUBES without extensive on-the-job pipe work.*

WALKER PROCESS **Walker Process Equipment Inc.**

FACTORY • ENGINEERING OFFICES • LABORATORIES • AURORA, ILLINOIS

# Men and Firms

Louis G. Puls, formerly chief designing engineer for the U. S. Reclamation Bureau Agency in Denver, Colorado, has entered private practice as a consulting engineer. In government service for more than 30 years, Puls has directed or supervised the design of dams, power and pumping plants, canals, and other structures for reclamation projects in the West, including Glen Canyon and Flaming Gorge dams on the Colorado River.

R. V. Lord and Associates, Boulder, Colorado, has moved into new quarters at 1845 - 24th.

Burton G. Dwyre, chief highway engineer for the Albuquerque and Santa Fe, New Mexico, consulting firm of Gordon Herkenhoff and Associates, has been installed as vice president for the 13-state Zone 4 of the American Society of Civil Engineers.

De Leuw, Cather & Company, Chicago, announces that Vice Admiral W. Orme Hiltabidle, Civil Engineer Corps, United States Navy (Ret.), formerly vice president, Chas. H. Tompkins Co., has joined its organization as consultant, with offices at 1308 Eighteenth Street, N. W., Washington 6, D. C.

Mianulli, Padron, Guarniero, Campbell and Schwartz is a consulting organization providing professional services in the fields of civil, sanitary, mechanical, and electrical engineering; and construction. The consulting association is the result of the merger of several consulting engineering organizations with its main office at 185-87 Montague Street, Brooklyn, New York.

Harry Czyzewski, president of Metallurgical Engineers, Inc., Portland, Oregon, has been reappointed a member of the Industrial Development Committee of the statewide Associated Oregon Industries.

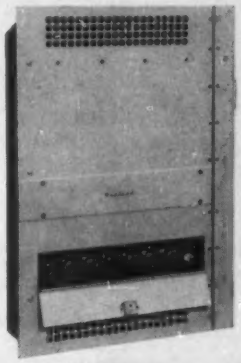
Formation of a three-man executive committee to direct the operations of Arthur G. McKee & Company (Cleveland, Ohio) and its subsidiaries has been announced. Chairman of the committee is H. R. Moorhouse, executive vice president and treasurer since 1958, who has been named administrative executive vice president. The other two members are Merrill Cox, formerly vice president of sales for the company's metals division, who has been named executive president responsible for all activities of that division; and William B. Hudson, who has been named executive vice president responsible for all activities of the petroleum and chemicals division.

Donald M. Ditmars and David W. Carmichael announce the establishment of the consulting engineering firm of Ditmars and Carmichael,


**UNIQUE**
**SOUND SYSTEM** design
*by*
Rauland

**Exclusive New 30-Watt**
**IN-WALL AMPLIFIER**

***permits inconspicuous, space-saving mounting for any permanently installed Sound System . . . no longer any need to specify an amplifier on an open shelf***



MODEL 2030

**NEW FLUSH DESIGN**

**Installs flush in frame or masonry wall; only 4" depth required. Entire amplifier is mounted on heavy-aluminum hinged door for easy servicing. Controls are accessible through key-locking hinged front panel. Backbox has ¾" knockouts.**

Control Panel Locked

Amplifier Swings Out for Service

**ALL-TRANSISTOR AMPLIFIER**

**Advanced audio circuit uses 12 transistors and a Zener Diode; no tubes; 4 low impedance microphone inputs are provided for full 30 watts of clean, crisp audio power. Ruggedly designed and built; well-ventilated for continuous 24-hour operation.**

**This brilliant new amplifier design is ideal for use in auditoriums (mounted to rear of audience), for gymnasiums, or wherever a permanently installed sound system is desired.**

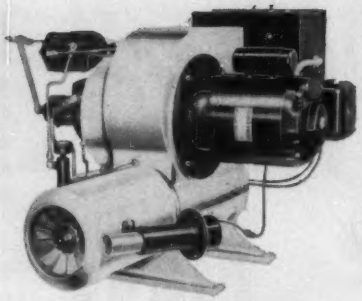
Rauland

***ASK FOR* Specification Sheet giving detailed description of the Model 2030 In-Wall Amplifier.**

**RAULAND-BORG CORPORATION**

**3535-D Addison St., Chicago 18, Illinois**

# INDUSTRIAL COMBUSTION



## HEV-E-OIL BURNER
**saves fuel & operating costs**

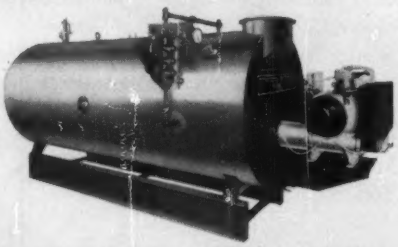
Especially engineered to make use of inexpensive No. 4, 5 and 6 heavy oils. Only burner to apply successfully the principle of low pressure air atomization of heavy fuel oils *inside the burner nozzle*. Eliminates costly maintenance.

Write Dept. B-121 for nation-wide listing of HEV-E-OIL Burner installations.

- Ready to install — factory assembled — completely wired.
- All combustion air is furnished by the burner.
- Simple installation saves money.
- Factory trained service men available throughout the country.

## HIGHLANDER AUTOMATIC BOILER-BURNER
**low or high pressure steam or hot water**

You can rely on this HIGHLANDER for *all* heating or power applications. Choice of burners for heavy oil, light oil or combinations of gas/light or gas/heavy oils.



- Easy maintenance of boiler and burner.
- Burner fire tested at factory.
- Entire unit Underwriters Laboratory Approved — Certified rating for output.

**INDUSTRIAL COMBUSTION INC.**
Executive Offices:
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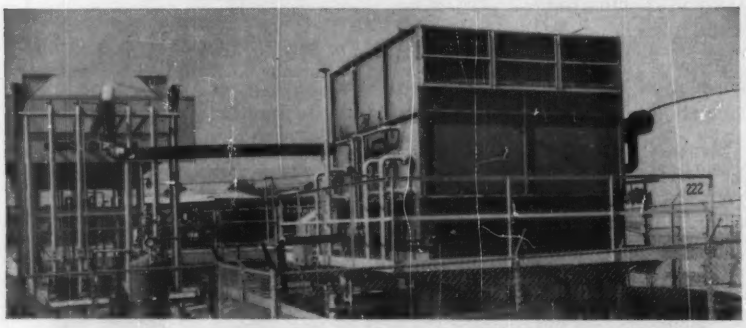


# SAVE POWER AND COOLING WATER USING AIR TO CONDENSE VAPORS

NIAGARA *AERO*® VAPOR CONDENSERS give sustained full capacity in condensing vapors by evaporative cooling with only nominal use of water. You have no problem of water availability, or disposal, or quality, or temperature.

The system is self-contained . . . no cooling tower or spray pond is required. You save not only the cost of condensing water but also the expenses of piping and pumping, and the cost of water handling equipment.

In the Niagara Vapor Condenser the heat is removed at the rate of input and the cooling effect, directly proportional to the load, is controlled by varying the amount of air passing over the cooling surfaces. Operation is automatic and trustworthy.

Liquids and vapors are always held at constant temperature under close control. You get uniform distillation products the year round. You get better quality and increased production.

Non-condensibles are effectively separated and sub-cooled, giving you better vacuum pump operation. You save power and steam.

Niagara *Aero* Vapor Condensers are manufactured in standard units in a range of capacities up to thirty million BTU's. Write for full information; ask for Bulletin 139-R.

**NIAGARA BLOWER COMPANY**
Dept. CO-12, 405 Lexington Ave., New York 17, N. Y.
*Niagara District Engineers in Principal Cities of U.S. and Canada*


with offices located at 20 Nassau Street, Princeton, New Jersey.

Phillips L. St. John, P.E. and Robert E. Wetmore, P.E. have been named partners of Leigh E. St. John and Associates, consulting engineers, with offices at Binghamton and Buffalo, New York.

The following appointments have been announced by Associated Construction and Engineering Company, South San Francisco, California: Oscar Washam has been elevated to vice president in charge of construction; C. Jack Woodruff also moves up to a vice president's position; George H. Jennings becomes vice president in charge of engineering; and Harold E. Koerber becomes the assistant to the president.

Thomas A. Fearnside and Dr. Arthur J. Good have been elected to the board of directors of Stone & Webster Engineering Corporation. Fearnside, a mechanical engineer, joined the company in 1940, became engineering manager in 1960, and was named a vice president earlier this year. Dr. Good, who holds a doctorate in chemical engineering from the University of Michigan, was named comptroller in 1957, a vice president in 1958, and treasurer in 1960.

Ralph E. Meints, formerly a partner in the firm of Vern E. Alden Company, Chicago, has left that partnership and now is associated with the Leonard Construction Company.

Burns and Roe, Inc., New York City consulting engineers, announces the formation of Burns and Roe Argentina, Socieded Anonima. The new subsidiary will have headquarters at Avenida Roque Pena 547, Buenos Aires. Directors of the subsidiary are: K. A. Roe, executive vice president and M. A. Forrest, vice president, project operations of Burns and Roe, Inc.; and

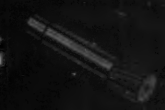
designed for **LONG LIFE**

...life-long **dependability**

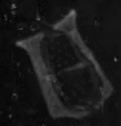
Only U.S. SYNCROGEAR has all these features...

**RUGGED PYRAMIDAL CASE** prevents distortion or misalignment.

**SOLID SHANK BUILT-IN PINION** can't vibrate or work loose.



**ASBESTOS PROTECTED WINDINGS** will not deteriorate from heat.



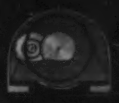
**ONE-PIECE SUPPORTING CASE** assures permanent alignment of gears, pinions.

**THROUGH-HARDENED GEAR TEETH** give greatest strength, longest wear.

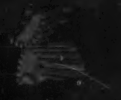
**NORMALIZED CASTINGS** prevent warping, misalignment of gears, shafts.

**FRICTION-FREE OIL SEAL** can't wear, prevents leakage.

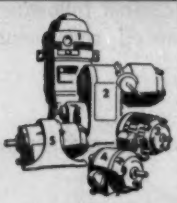
**POSITIVE AUTO-LUBRICATION** by slow-gear dip prevents churning



**MICRO-SHAVED AND HONED GEAR TEETH** provide smooth operation, long life.

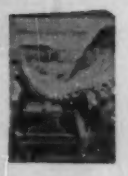


**U.S. SYNCROGEAR MOTORS** offer the *most features* to provide long life and dependability. For a quarter-century, U.S. Syncrogears have led design progress. (Available 1/3 to 75 h.p.—single-, double-, triple-reductions, and worm-geared.)



**U.S. MAJOR MOTOR LINES INCLUDE:**
1. Vertical Solid & Holloshaft, 2. Varidrive, 3. Totally-Enclosed, 4. Uniclosed, 5. Syncrogear. Also, many other special motors.

**FREE SYNCROGEAR BROCHURE No. F-1880**
*Color illustrated*



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SINGLE PASSAGE IMPELLERS
WITH MULTI-BLADE BALANCE
AURORA MONO-VANE NON-CLOG PUMPS
BENEFIT FROM THE SPECIAL ADVANTAGES OF SINGLE PASSAGE IMPELLERS, WITHOUT THE USUAL VIBRATION.
The Mono-Vane patented design provides a natural rotational and mechanical balance. There is no need for separate counterbalance . . . and the Mono-Vane can be trimmed to suit various head and capacity requirements, retaining balance through the entire curve from shut-off to wide-open.
The Mono-Vane impeller is especially effective for long, stringy materials . . . and it is up to 20 times more non-clog than the conventional 2-blade impeller. Maximum economy of investment and operation is assured . . . the Mono-Vane operates effectively for a given head and given solids size at ½ the capacity and ½ the horsepower.
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LOCAL DISTRIBUTOR IS LISTED IN THE YELLOW PAGES OF YOUR PHONE BOOK

H. P. R. Prisk, the parent company's representative in Argentina.

The California Legislative Council of Professional Engineers elected the following officers for 1961-1962: president, Leroy F. Greene, consulting engineer, Sacramento, a delegate from ASCE, Sacramento Section; vice president, Donald R. Schumacher, Dow Chemical Co., Pittsburg, California, delegate from ASME, northern California; Philip Abrams, consulting engineer, Palm Springs, delegate from ASCE, Los Angeles Section; and secretary-treasurer, Jack Y. Long, partner in J. Y. Long Co., consulting engineers, Oakland, delegate from ASCE, San Francisco.

GREENE

STROHMEYER

Charles Strohmeyer, Jr., senior mechanical engineer, Gilbert Associates, Inc., Reading, Pennsylvania, received the 1961 Prime Movers Committee Award at a recent Power Conference of the American Society of Mechanical Engineers. Strohmeyer was honored for his development of outstanding new concepts in the field of electric generating plant design.

Henry C. Goodrich, vice president of The Rust Engineering Company, Pittsburgh and Birmingham, has been elected a director of the firm. Goodrich has been a vice president of Rust Engineering in the Birmingham office since 1956.

Walter C. Hopkins has accepted a position as vice president of Michael Baker, Jr., Inc. following his recent announced retirement

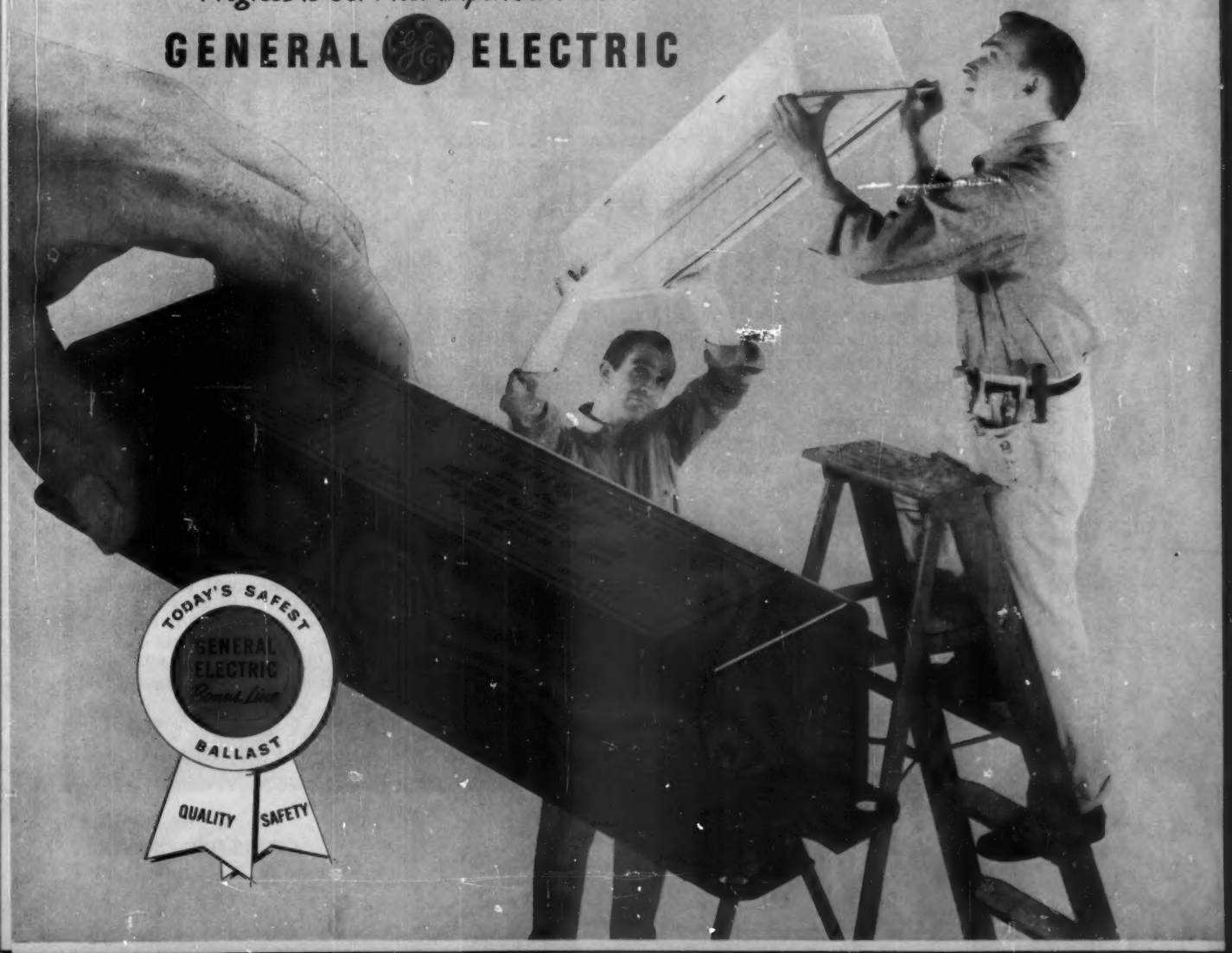
Your lighting projects require the *safest* fluorescent ballasts you can specify . . . General Electric Bonus Line*. These ballasts are designed to protect against leaking, smoking, burning—*all* potential hazards or annoyances at end of life. They feature a unique, non-resetting thermal protection system—better than the best fusing—for unmatched, incident-free operation throughout their full, useful life. Put the fullest measure of lighting protection into your buildings. Write premium-quality General Electric Bonus Line ballasts into your lighting specifications.

*Trade-mark of General Electric Company

For a detailed engineering report on Bonus Line ballasts, contact your G-E Sales Engineer or write Section 403-03, General Electric Company, Danville, Illinois.

*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**



FLIP-TOP
ROOF VENTILATOR
cuts Maintenance Cost

Entire motor-and-fan housing may be flipped back 90° to make motor, drive assembly and fan conveniently accessible above roof level. Such easy access to all working parts for quick inspection cuts maintenance costs substantially by saving time and making the work easier.

This new DeBothezat "flip-top" Power-Flow roof ventilator offers fan wheels from 12" to 48" in diameter and capacities to 43,070 CFM. A Vertical Discharge Model exhausts dust and oil-laden air at high velocity, to disperse contaminants high enough to prevent their re-entry into building's air supply.

***Write for illustrated Bulletin DB-7-61***

AMETEK
DeBOTHEZAT FANS
A DIVISION OF AMETEK, INC.

Dept. CED-1261, EAST MOLINE, ILLINOIS

from the Maryland State Roads Commission. Hopkins will be in charge of the firm's operations in the Philippines.

Charles Dunham is now project engineer in the structural department, Koebig and Koebig, Los Angeles. He formerly taught in the engineering department at Los Angeles State College.

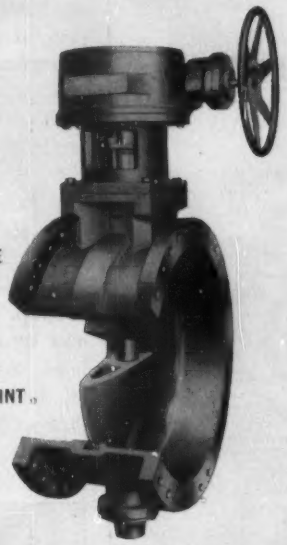
Frank Galbraith has been appointed chief research engineer, special projects division, Holmes & Narver, Inc., Los Angeles. He was formerly assistant chief research engineer.

It also has been announced that Norman B. Jones, formerly chief structural engineer, petrochemical division, Ralph W. Parsons Company, has joined the firm as chief structural engineer of the industrial division.

Jacobs Engineering Company, Pasadena, California, announces the formation of a subsidiary, Jacobs Constructors, Inc., to handle construction and contract maintenance of process plants throughout the world. Officers of the construction firm are: Dr. Joseph J. Jacobs, president; Stanley L. Krugman and John J. Harrington, vice presidents; Robert M. Barton, secretary; and Karl E. Barth, assistant secretary.

Henry M. Ford, recently retired from state service, has joined the staff of Mead and Hunt, Inc., consulting engineers, Madison, Wisconsin, as a planning and engineering coordinator. Ford served as Deputy Director, Department of Resource Development, State of Wisconsin, and also was the State Director of Regional Planning for five years.

L. E. Cramer, consulting engineer, has formed the firm of Cramer Associates, with offices at 429 West Scott Avenue, Fresno, California. Cramer is a former Bureau of Rec-



STANDARD

SINGLE FLANGE

INSERT VALVE (Butterfly in gate body)

COMBINATION VALVE AND EXPANSION JOINT

METAL SEAT

TANK TYPE REVERSING

CROSS TYPE REVERSING

OBROUND

RECTANGULAR

SPECIAL ENDS

# Henry Pratt offers many types of standard and special RUBBER SEAT BUTTERFLY VALVES

Henry Pratt Rubber Seat Butterfly Valves can fill a surprising range of job requirements. When you need big valves, 24 inches to 14 feet diameter, review these operating and construction features with a Henry Pratt engineer—and you'll also find a truly useful fund of application experience.

## OPERATING AND CONSTRUCTION FEATURES

**Adjustable rubber seat** . . . for truly bubbletight fitting of disc to seat. Makes adjustment or even replacement easy in accessible pipe lines. New exclusive Dual-Durometer rubber formulation offers highest pressure leakproof service—yet affords lowest seating torques in the industry.

**Long operating life** . . . through accurate control of seat-disc interference, gives tight fit without wear.

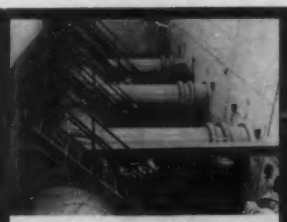
**Valve Body** . . . made of cast iron, fabricated steel or special alloys, depending on service conditions.

**Streamlined valve disc** . . . contoured for lowest possible resistance to flow. The non-corrosive disc edge is hand ground and polished to reduce wear.

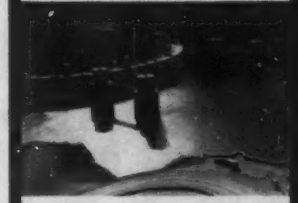
**One piece shaft** . . . of type 304, type 316SS or Monel. Conservatively sized for full pressure drop across closed disc.

**Operators** . . . Wide selection to meet all service conditions.

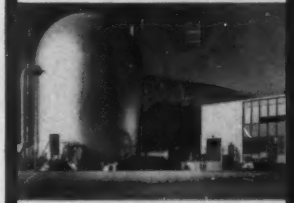
Write for 50-page catalog for full details on flow rates, etc. Ask for **Catalog B-3J.**



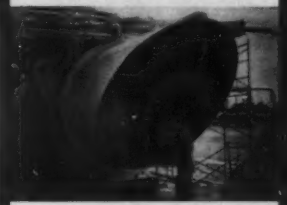
WATER WORKS



HYDRO-ELECTRIC POWER



NUCLEAR POWER



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POWER PLANTS

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**SPECIFIED BY:**

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and scores of others

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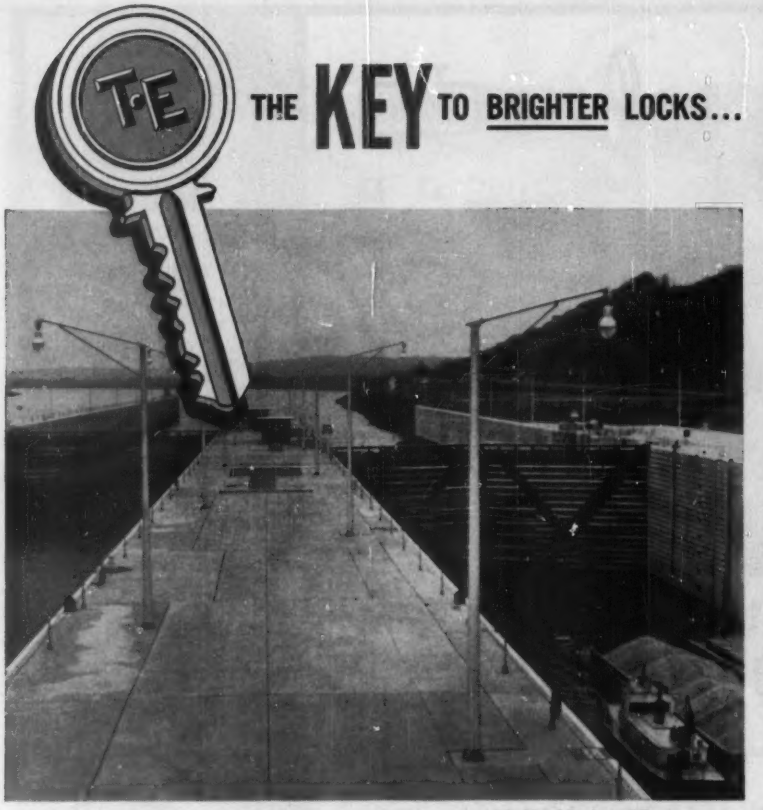



*Markland Locks and Dam on the Ohio River.*

# THOMPSON servisafe POLES

Safe navigation through the busy Markland Locks on the Ohio River depends on the skill of experienced river pilots and bright uniform illumination. That's why Thompson Servisafe poles were specified by the engineers who designed the installation. As the lights are lowered, they are automatically disconnected. Maintenance personnel can replace burned-out bulbs and service fixtures on the ground . . . quickly and with complete safety.

*Request full details on specs, installation and costs.*

THE THOMPSON ELECTRIC COMPANY
P. O. Box 873-B • Cleveland 22, Ohio


lamation engineer with supervising design and construction experience at a number of the Bureau's important projects. The new firm will practice general engineering with particular emphasis on works for irrigation.

The engineering and architectural firm of Praeger-Kavanagh-Waterbury, New York, has named Charles D. Morrissey to the partnership. Morrissey joined the firm nine years ago and recently has been associated with a number of defense projects designed by Praeger-Kavanagh-Waterbury.

MORRISSEY

ALLEN

Charles J. Allen, associate in the firm of Albert Kahn Associated Architects and Engineers, Inc., Detroit, has been appointed assistant chief mechanical engineer.

Horace J. Whitacre, Tacoma, representing the Consulting Engineers Association of Washington, was one of the featured speakers at the recent third annual Missile Symposium in Seattle, sponsored by the Washington Department of Commerce and Economic Development. Whitacre discussed "How Consulting Engineers Can Help You — and Save You Money."

Ebasco Services Incorporated has announced the appointment of Samuel B. Smith as chief consulting engineer, and Herbert L. Lowe as consulting electrical engineer. Smith succeeds Robert E. Pierce, who continues with the company as a general engineering consultant. Lowe, who was chief electri-

General Offices of Burns & McDonnell, Engineers and Architects, Kansas City, Missouri. Comfortably cooled at low cost with gas-operated Ready-Power Air Conditioning.

# GAS-operated READY-POWER air conditioning costs less than one cent per ton-hour!

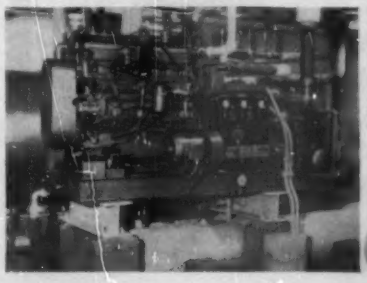
In office buildings, clubs, churches, theatres, bowling alleys, stores, factories . . . for every type of commercial and industrial air conditioning application . . . gas-operated Ready-Power units condition air with extremely low input per ton-hour.

All Ready-Power units average less than 13 cubic feet of natural gas per ton per hour. What's more, the total operating cost amounts to *less than one cent per ton per hour.* What makes this possible? Ready-Power air conditioning combines the unmatched fuel economy of gas with a unique variable speed operation. LOAD-MATCH CONTROLS automatically adjust output and fuel consumption to actual cooling requirements. Cooling is constant, as opposed to the ON-OFF operation of some systems.

Get all the facts on the unusual economy, dependability and efficiency of gas-operated Ready-Power Air Conditioning.

Call your local Gas Company, or write to The Ready-Power Company, Detroit 14, Michigan.

*American Gas Association*



**Gas-operated Ready-Power Air Conditioning uses natural gas engine-driven compressor units, condensing units or matched chiller-condenser units. Ready-Power offers packaged systems with capacities from 20 to 375 tons.**

**FOR AIR CONDITIONING GAS IS GOOD BUSINESS!**

*You'll need me in your chimneys*

Large industrial chimneys present a real problem in protection. They must withstand high temperatures, corrosive gases and moisture condensation. For more than 25 years, Sauereisen Acid-Proof Cement No. 31 has proved itself superior in over 200 chimney installations throughout the world. Ask for Data Sheets.

***Sauereisen Cements Co.***
***Pittsburgh 15, Pa.***

**SAUEREISEN**
Acid-Proof CEMENT **No. 31**

**You DON'T Need**

BOLTS WASHERS NUTS PINS

**or Special Tools to install**

*Chalfant*

**Cable Support Systems**

Chalfant Splice Plates and Trays are securely fastened by the exclusive Chalfant Crimping Method . . . to reduce installation time way below conventional methods. Lower costs are also achieved with Chalfant systems because each splice plate and tray is made from high quality, longer lasting, economical Aluminized steel.
You'll save 15% on material and 40% on installation when you use Chalfant Systems to produce a better job.

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Will there be dust-producing machines in your client's new plant? Such as metalworking, wood-working or penumatic conveying equipment? If so, you should plan now for dust control.

Because dust clogs and gums up costly machinery, lowers production efficiency, causes breakdowns and higher maintenance costs. In addition, dust is harmful to the health of employees.

More and more professional men, laying out new plants and remodeling older ones, are specifying Torit Dust Collectors. Torit Dust Collectors have proved 98% efficient in removing dust. They are compact, easy to install and maintain, and cost far less than many types of dust collecting equipment.

Contact a Torit representative. He will give you dust collector specifications, performance charts, dimensional drawings, installation suggestions . . . all the information you need.

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**MANUFACTURING COMPANY**
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Cyclone model. *Also available in portable cabinet models.*


cal design engineer, is succeeded by Theron C. Hoyt.

The consulting practice of Guy B. Panero Engineers is being continued by the firm of Guy B. Panero, Inc. Officers are: chairman of the board, Guy Arthur Panero; director, Robert B. Panero; president, Fritz Kindler; vice presidents, Albert M. Laukaitis, Jack W. Barrett, Robert M. Pope, and Basil J. Candela; secretary-treasurer, Robert C. Sussman.

A new firm, Barton, Brown, Clyde & Loguidice, has been formed for the practice of consulting engineering and land surveying, with offices in the Northern Lights Office Park, Syracuse, New York. Partners of the new firm are Edwin J. Barton, Kenneth R. Brown, James E. Clyde, and Frank A. Loguidice. The new firm's primary areas of practice will be in the fields of civil and sanitary engineering.

Nick Hernandez, design engineer for Harza Engineering Company International, was honored recently by King Hussein of Jordan with a gift of two gold wrist watches, the second watch being for Hernandez's son, born in 1960 in Jordan. Hernandez has completed two years work on the East Ghor Irrigation Project of the East Ghor Canal Authority, and the gift from the King was in recognition of that service.

Andrew Krafczyk, a vice president of Johannessen & Girand, consulting engineers, Phoenix, Arizona, has been assigned to the firm's Bangkok, Thailand, office, to supervise preliminary engineering work on a number of airfields in Southeast Asia.

Johnson and Anderson, Inc., consulting engineers of Pontiac, Michigan, has announced the opening of an Arizona office at 4747 N. 16th Street, Phoenix, under the management of Robert H. Zumstein. ▲▲

It's all there, every detail sharp and clear, in RECORDAK precision 35mm microfilm images

# There's more to these RECORDAK pictures than meets the eye!

**RECORDAK precision 35mm microfilm images *more than meet DOD requirements*—give a minimum of 120 lines per mm resolution at 30-to-1 reduction ratio.**

Look closely at some RECORDAK microfilm images in a film reader. See how every detail is sharp and clear . . . how the backgrounds are remarkably uniform, even though the pictures you're looking at were made from drawings and prints of every type and age.

How do these RECORDAK pictures come out so well?

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Your staff can easily be trained in the use of RECORDAK Micro-File equipment especially calibrated to produce images which meet DOD requirements.

This is important, for your success with an automated engineering drawing program depends *mainly* on the quality of the pictures you use, and on the quality of the prints you can make from them.

***Free booklet*** goes into more details on precision microfilming available through Recordak or a Microfilming Dealer of Recordak.

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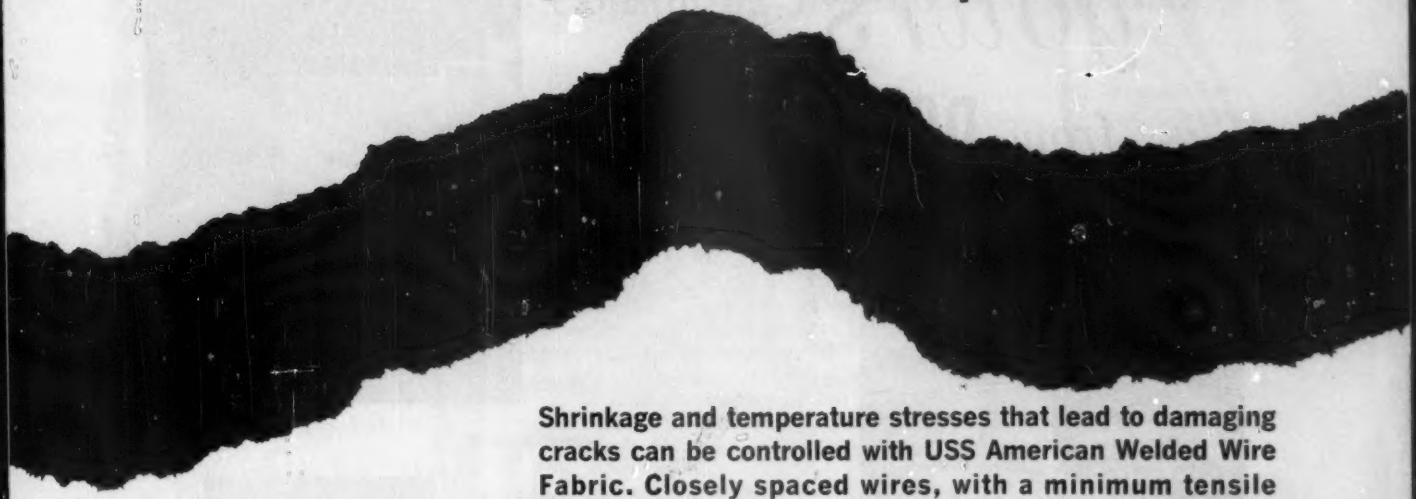
# Control concrete temperature cracks



Shrinkage and temperature stresses that lead to damaging cracks can be controlled with USS American Welded Wire Fabric. Closely spaced wires, with a minimum tensile strength of 75,000 psi, distribute the required area of steel evenly throughout the entire concrete slab. And electrically welded intersections anchor the steel in both directions.

Prevents damaging cracks. The yield strength is figured at 80% of the ultimate strength or 60,000 psi. Thus, 50% greater design stress is permissible than with most hot rolled reinforcing steels. The result is that USS American Welded Wire Fabric will be effective in preventing damaging cracks in a concrete structure at a much higher stress. Spacing of each reinforcing member is guaranteed to a tolerance of ±¼" and cold drawn to a tolerance of .003".

Welded Wire Fabric eliminates the costly, tedious tying of bars and assures the steel being positioned exactly where needed. Convenient rolls or flat sheets sized to your specifications save time and reduce costs.

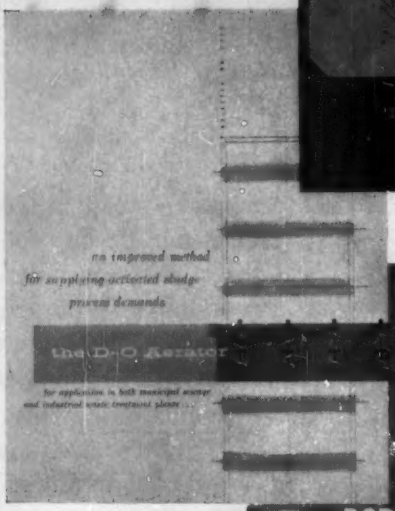
All concrete slabs on fills or grade should be reinforced with welded wire fabric . . . it adds 30% to the strength of a plain concrete slab. Thus, the cost of a reinforced concrete slab is much less than an unreinforced slab of equal strength. For the full story, call or write American Steel and Wire, Dept. 1293, Rockefeller Bldg., Cleveland 13, Ohio. USS and American are registered trademarks.

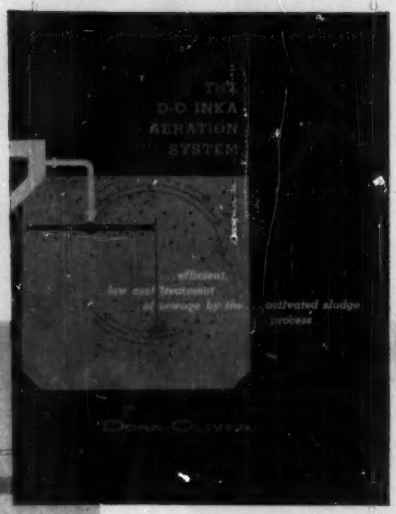
***Innovators In Wire***

**American Steel and Wire**
**Division of**
**United States Steel**

Columbia-Geneva Steel Division, San Francisco
Tennessee Coal and Iron Division, Fairfield, Alabama
United States Steel Export Company

# *yours*
## *from* DORR-OLIVER



*Valuable new information describing*

# NEW EQUIPMENT FOR ACTIVATED SLUDGE TREATMENT

Climaxing almost 10 years of research, Dorr-Oliver® now presents four advanced developments in equipment for treatment of sewage and industrial wastes by the activated sludge process.

Thoroughly proven in full scale plant installations, they offer the consultant or sanitary engineer new opportunities for efficient sewage plant design and maximum flexibility in meeting a particular need.

Basic information is contained in the four newly published bulletins shown above. The equipment described comprises:

1. **THE D-O® AERATOR**
   An improved method for providing highest oxygenation capacities and transfer efficiencies.
2. **THE D-O INKA AERATION SYSTEM**
   A unique new design using low pressure air for activated sludge aeration.
3. **THE DORR-OLIVER SPIROVORTEX® SYSTEM**
   Combines the simplicity of Biofiltration® with activated sludge treatment performance and efficiency.
4. **THE DORR® RSR CLARIFIER**
   Minimizes sludge detention in final clarifiers. Design features allow rapid return, positive control, and visual assurance of continuous removal of activated sludge.

For copies of these bulletins, write Dorr-Oliver Incorporated, Stamford, Connecticut.

DORR-OLIVER
WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT

# Consulting Engineers' Calendar

*Dec. 3-6.* American Institute of Chemical Engineers; General Meeting, New Yorker Hotel, New York, N. Y.

*Dec. 6.* American Institute of Consulting Engineers; Luncheon Meeting, Engineers' Club, New York City.

*Jan. 8-12.* Highway Research Board, National Academy of Sciences, National Research Council; Annual Meeting, Sheraton-Park Hotel, Washington, D. C.

*Jan. 11-13.* New York State Society of Professional Engineers; Winter Meeting, Schenectady, New York.

*Jan. 15.* American Institute of Consulting Engineers; Annual Meeting, Engineers' Club, New York, N. Y.

*Jan. 22-Feb. 1.* University of California Extension; Short Course on "Engineering and Management," Campus, UCLA, Los Angeles, Cal.

*Jan. 25-27.* National Society of Professional Engineers; Meeting, King Edward Hotel, Jackson, Mississippi.

*Jan. 28-Feb. 2.* American Institute of Electrical Engineers; Meeting, Hotel Statler, New York, New York.

*Jan. 29-31.* American Society of Heating, Refrigerating, and Air Conditioning Engineers; Meeting, Chase-Park Plaza, St. Louis, Missouri.

*Feb. 4-7.* American Institute of Chemical Engineers; National Meeting, Statler Hotel, Los Angeles, California.

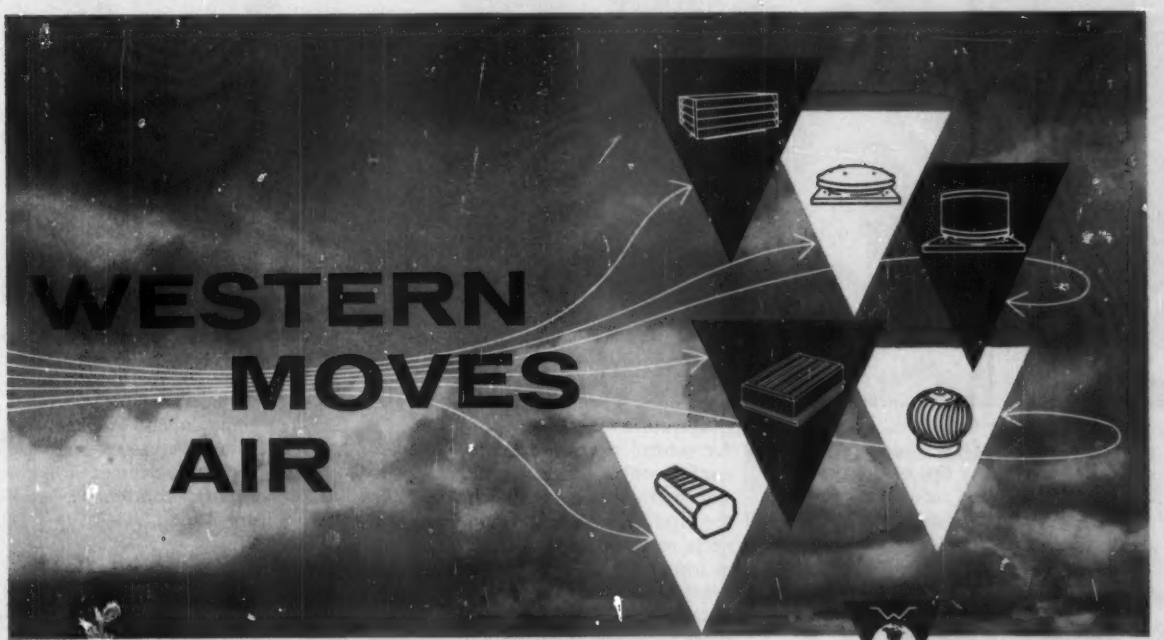
*Feb. 12-15.* Air-Conditioning and Refrigeration Institute; 12th National Exposition, Los Angeles, California.

*Feb. 13-14.* Division of Sanitary Engineering, Illinois Dept. of Public Health and Dept. of Civil Engineering, University of Illinois; Sanitary Engineering Conference, Urbana, Ill.

*Feb. 17-22.* National Bituminous Concrete Association; Annual Convention, Flamingo Hotel, Las Vegas, Nevada.

*Feb. 18-22.* American Institute of Mining, Metallurgical, and Petroleum Engineers; Annual Meeting, New York.

*Feb. 19-23.* American Society of Civil Engineers; Convention, Hotel Shamrock, Houston, Texas.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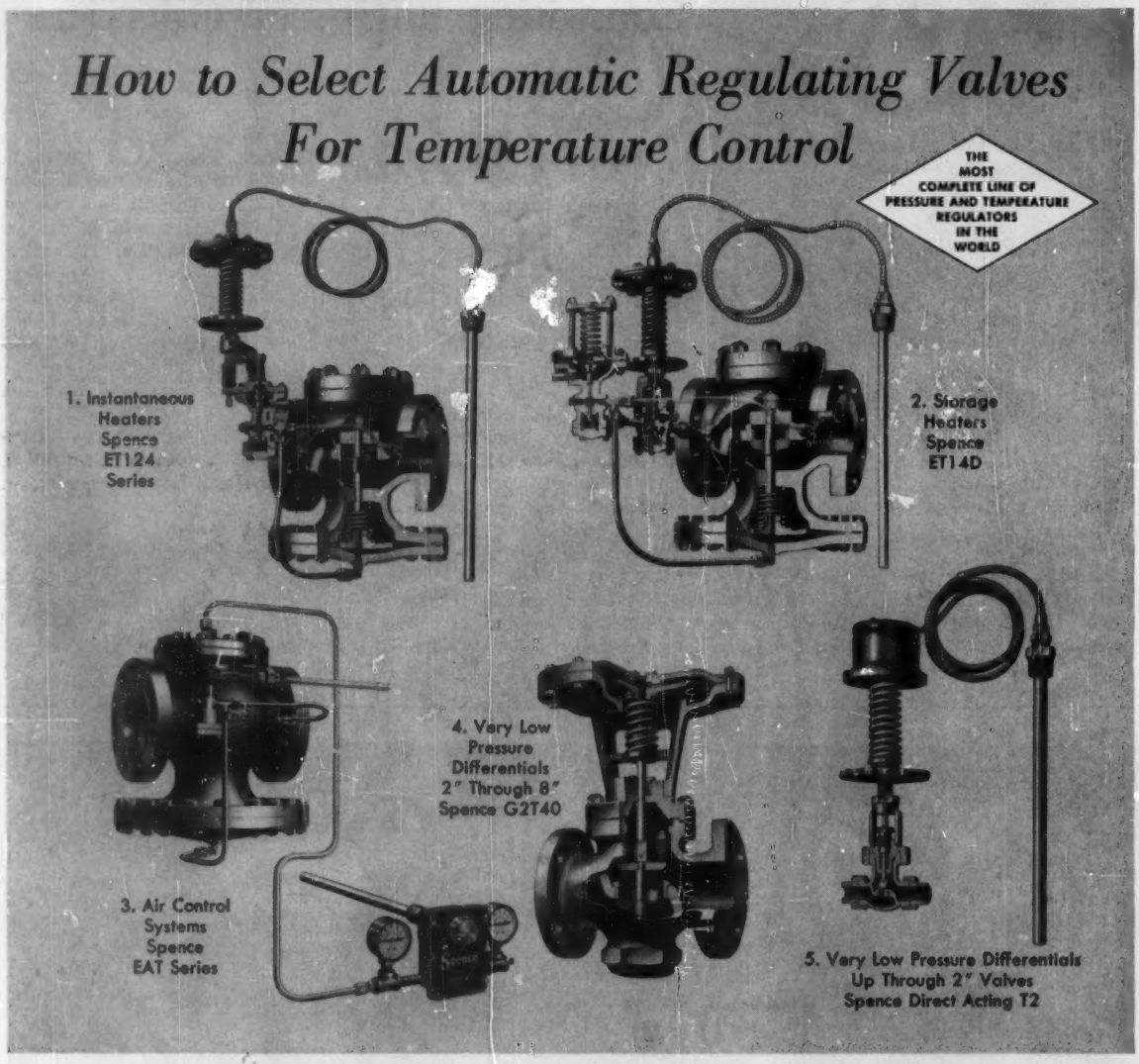
## VALVE TIPS:

# *How to Select Automatic Regulating Valves For Temperature Control*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1. Instantaneous Heaters Spence ET124 Series
2. Storage Heaters Spence ET14D
3. Air Control Systems Spence EAT Series
4. Very Low Pressure Differentials 2" Through 8" Spence G2T40
5. Very Low Pressure Differentials Up Through 2" Valves Spence Direct Acting T2

During the past year, our field representatives have reported many cases of improperly, and uneconomically, applied temperature regulators. To help you avoid some of these costly mistakes, here are a few tips on selecting the most effective and economical temperature regulating valves for your applications.

1. Instantaneous heaters require a special action for close temperature control and freedom from hunting. In the Spence ET124 series, steam pressure is modulated according to temperature (demand) and is automatically regulated at any pressure established by the demand.
2. Storage heaters, on the other hand, are more economically controlled by the Spence ET14D, which includes a simple temperature-actuated pilot that opens and closes the main valve to maintain a constant temperature.
3. Air control systems can now have a ±5°F control accuracy under wide and instantaneous load swings with the Spence EAT regulator. Engineers report savings of up to 50% in installed costs with this recently developed Spence cascade system when it has been used in place of conventional instrumentation.
4. For the combination of very low pressure differentials and air or water control, Spence recommends Type G2T40. This single seated pilot operated valve provides fast, positive response in 2" through 8" valves. Double seat Type G22 is also available in 10" through 12".
5. When very low pressure differential is encountered with valves of 2" or less, the Spence direct operated T2 is recommended. The sensitive vapor tension thermostat responds quickly to small changes in bulb temperature for continuous, accurate control.

In this brief description of industrial process and heating temperature control, we have given a few important tips in proper regulator selection. If you would like more detailed information on these control applications, write for the new Spence Temperature Control Bulletin IV 1014. SE-150

SPENCE ENGINEERING COMPANY, INC.
*Walden 1, N. Y.*
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"Computers Need Conditioned Air"
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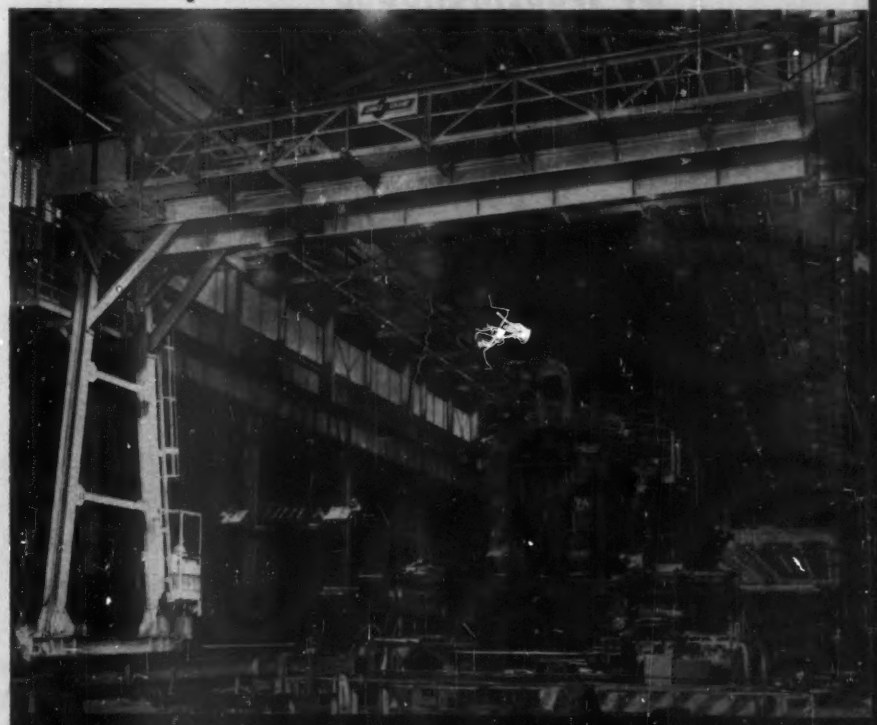

Conco Semi-Gantry Crane custom-engineered for service in a Chicago area steel mill

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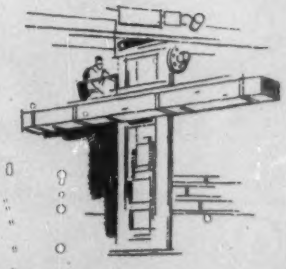

Write for Crane Specifications Tablet containing five sets of general service crane specification data and forms.

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Outwardly, the new auditorium is a 400′ stainless steel

J-94176-1

umbrella, suspended from a space frame cantilevered from the ground. That is one outstanding construction teamwork story.

Inside, coordination culminates in a control console located high above the seating area. From this station the

J-94176-2

*Construction Motivators: The Authority & Industry*
*l to r seated: Judge A. L. Wolk, Vice Chmn.; N. Stabile, Sec'ry Treas.; W. B. McFall, Chairman; H. R. Edelman, Jr., Pres. Heyl & Patterson; and D. J. McDonald, Vice Chmn.*
*standing: C. B. Jansen, Member; J. E. Bayne, V. P. Westinghouse; and Edw. Fraher, Exec. Director*

The six movable roof leaves are driven by Westinghouse right angle gearmotors, five to each leaf. Photo shows base of one of the movable leaves with the acoustic ceiling panels removed.

O. M. Newman, Heyl & Patterson, and Edward Cohen, Ammann & Whitney, discuss roof electrical drive with C. G. Falkenstein, Westinghouse, kneeling in front of main roof reactor control cabinet.

unique movable roof drive system is activated. An AC reactor control scheme keeps all six movable leaves in step throughout open and close cycles. Each leaf is driven by Westinghouse Moduline® gearmotors, with opposite leaves being operated in pairs.

Close cooperation among architects, engineers, owner, contractors and Westinghouse helped to provide a system flexible enough to serve varying building demands, with the high degree of electrical reliability required.

For more complete information on the electrical aspects of construction, write to: Westinghouse, P. O. Box 868, Pittsburgh 30, Pennsylvania.

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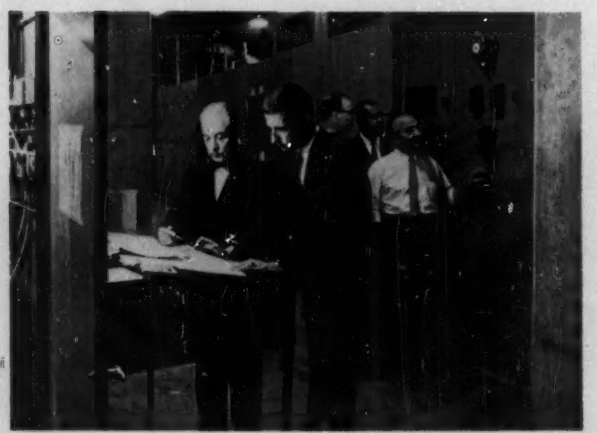
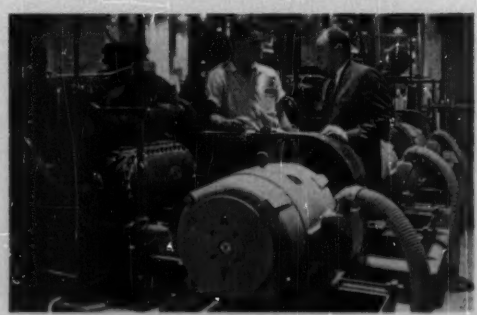
5KV metal-clad switchgear contains a tie-breaker to provide emergency switching between two incoming 4160-V lines. Seen here: N. J. Grady, V. P., Ernst, C. J. Long, and A. B. Janaszek.

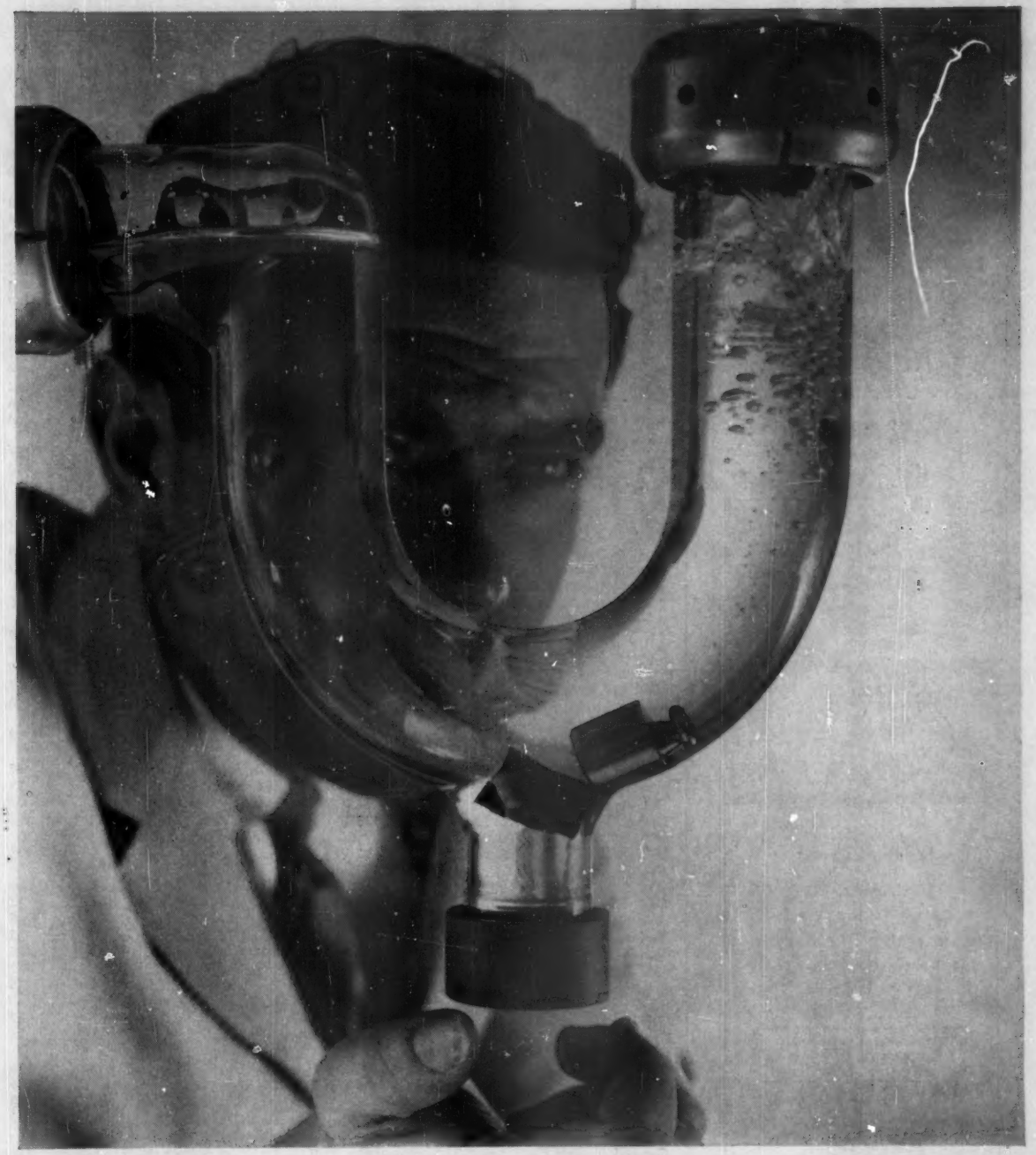


Checking construction progress are C. J. Long and F. J. Sarknas, Westinghouse. In background, 1500 kva power center supplies power for building auxiliary and air conditioning compressor motors.

Westinghouse Motor Control Center located in the Mechanical Room centralizes auxiliary motor controls. Discussing installation advantages are H. R. Helvenston, C. J. Long and N. J. Grady.



Three 125 hp Lifeline A motors drive freon compressors to chill brine supply for ice rink piping. Seen here are P. F. Schad, Limbach, and C. G. Falkenstein, Westinghouse.



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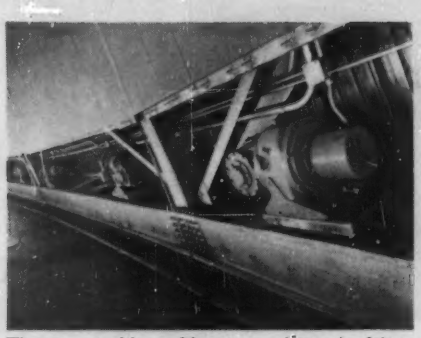

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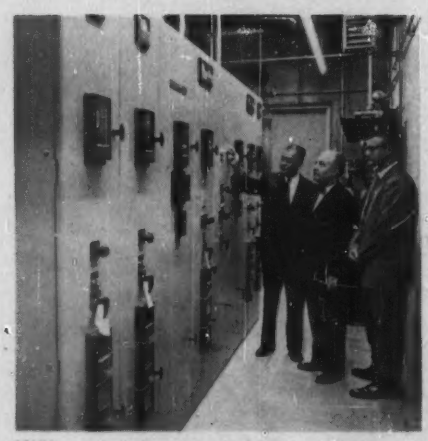

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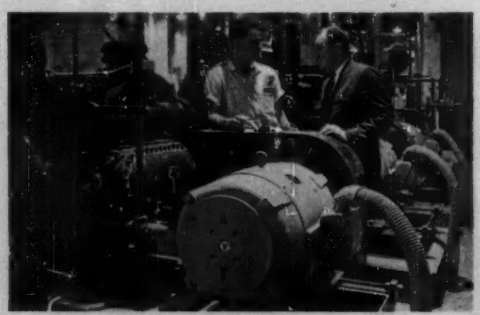


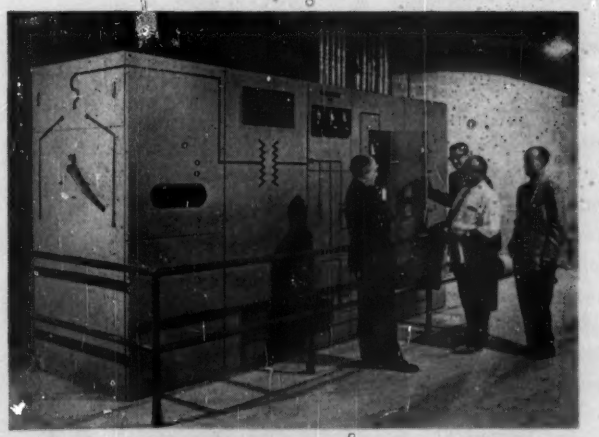
Three 125 hp Lifeline A motors drive freon compressors to chill brine supply for ice rink piping. Seen here are P. F. Schad, Limbach, and C. G. Falkenstein, Westinghouse.

Operator's view from roof control console high above the spectator area. Visible through the glass front is the juncture of the first two movable leaves of the roof.

One of main power transformers rated 2500 kva at 11.6 kv to 4160 volts. Discussing the power supply are C. J. Long, Electrical Engineer, M. A. Geffel, Ernst, and A. B. Janaszek, Westinghouse.

*Builder:* Public Auditorium Authority of Pittsburgh & Allegheny County: *Resident Engineer & Supt. of Construction:* H. Rey Helvenston
*Architects:* Mitchell & Ritchey, Pittsburgh
*Roof Designers & Engineers:* Ammann & Whitney, N.Y.
*Electrical Engineer:* Carl J. Long & Associates, Pittsburgh
*Mechanical Engineer:* John Mullin & Associates, Pittsburgh
*General Contractor:* Dick Corporation, Large, Pa.
*Electrical Contractor:* E. C. Ernst, Inc., Pittsburgh
*Mechanical Contractor:* Limbach Company, Pittsburgh
*Drive System Contractor:* Heyl & Patterson, Inc., Pittsburgh

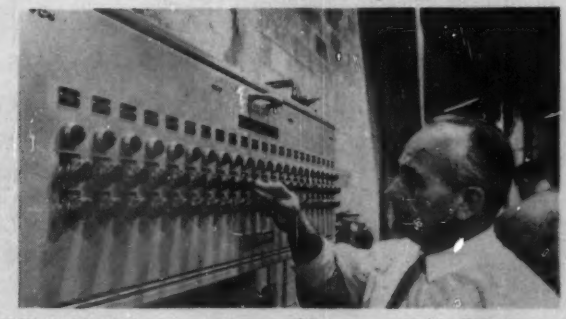
**Westinghouse**



Another Westinghouse power center, this 300 kva ASL dry type supplies lighting and auxiliary power. Discussing its component parts are C. J. Long, A. B. Janaszek, M. A. Geffel and Albert Simon, Ernst.

Type M Electric Stairway transports 8,000 persons /hr. Top to bottom: E. R. Gallagher, supervising architect; H. R. Helvenston, resident engineer; and A. Simmonds, Westinghouse Elevator.

Fan room equipped with series 8000 Air-Foil centrifugal fan and air conditioning coils. W. Y. Humphreys, Westinghouse, with John Mullin, Consulting Engineer, air conditioning and ventilation system designer.



Westinghouse mercury vapor parking area and floodlighting are operated from this remote control panel located in the mechanical room. M. A. Geffel, Ernst, tests lighting circuits.

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# Consulting Engineer

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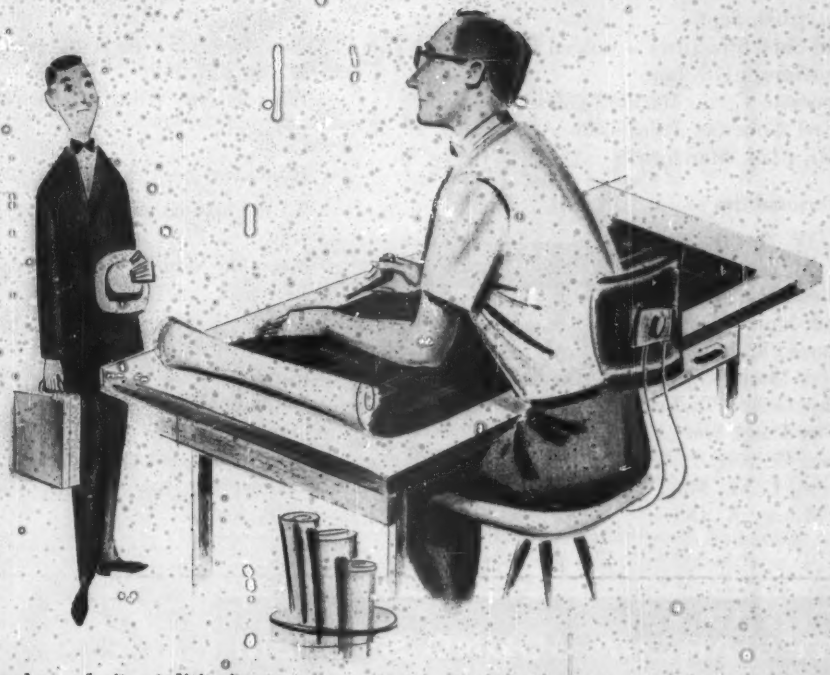
# The key to school air conditioning is in your hands...

**Changing educational patterns demand flexible schools with learning spaces equipped for year-round air conditioning under unitary control— as an economic necessity based upon educational productivity for the life of the building.**



New schools need air conditioning.
To produce the quality and quantity of education required in the future, school buildings must be free of the excess heat that shackles learning in many of the nation's classrooms from early spring to late fall.
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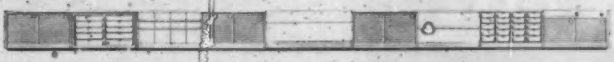
As you know, a renaissance in school design is already under way, stimulated by the need for controlled environment schools— and Nesbitt *Year-Round* Unit Ventilators are being widely employed as the preferred equipment for all-season thermal comfort in every learning space.
Nesbitt can help you to explain the importance of school air conditioning with slide films, case studies, cost data, publications, and other services.

MORE LEARNING PER SCHOOL DOLLAR

**Nesbitt** AIR CONDITIONING FOR SCHOOLS



Year-Round Unit Ventilator and Storage Cabinets • Made and sold by John J. Nesbitt, Inc., Philadelphia 36, Pa.

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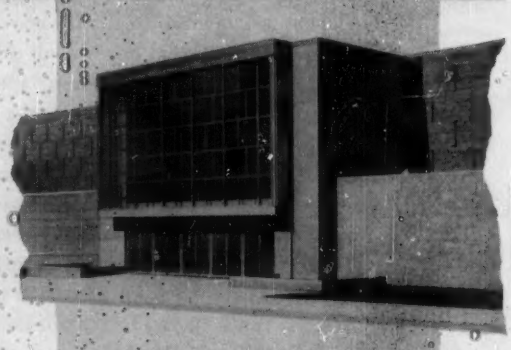
ALTEC ARENA SOUND SYSTEM SELECTED FOR MAXIMUM FLEXIBILITY, FINEST FIDELITY

**CASE HISTORY FILE 31-32:** New L.C. Walker Sports Arena in Muskegon, Michigan, has complete facilities for sports, entertainment, and civic events. Altec Sound Contractor: West Michigan Sound Company of Muskegon.



**SOUND PROBLEM:** Various events — sports, plays, conventions, rallies, musicals, meetings — take place at the Arena. Only hours after a concert, the arena may be filled by 8,000 shouting conventioneers or an equal number of rooting sports lovers. The sound system required remarkable flexibility to provide consistent quality under these dramatically variable conditions.

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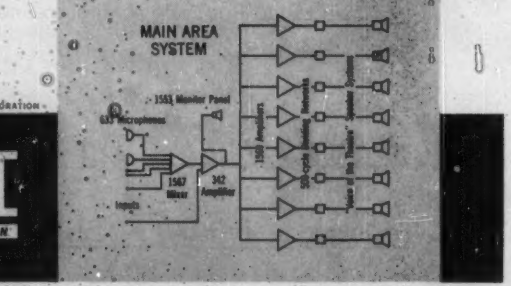


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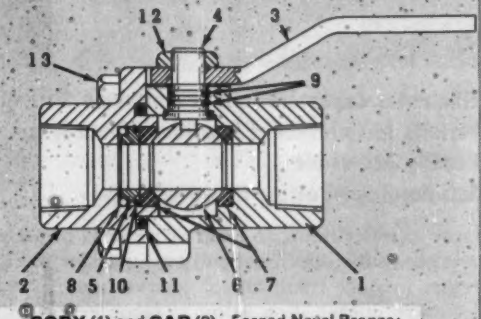


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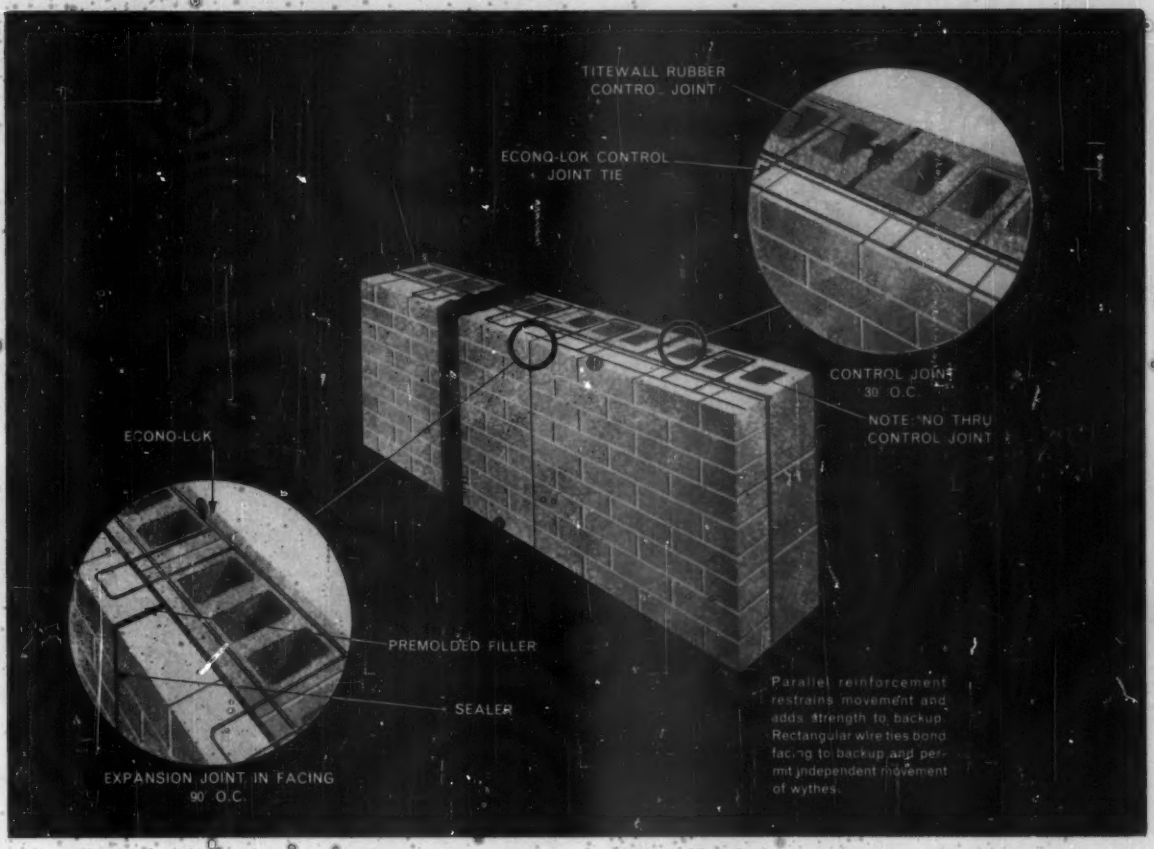
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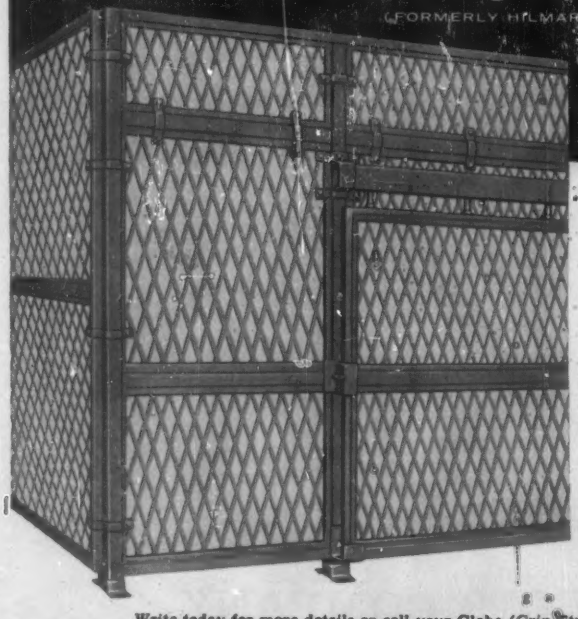

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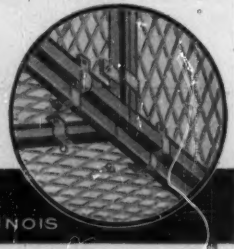

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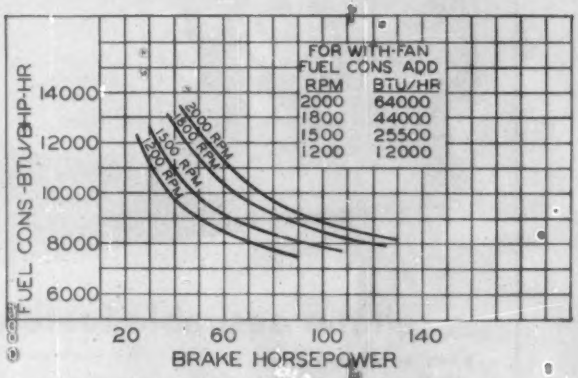


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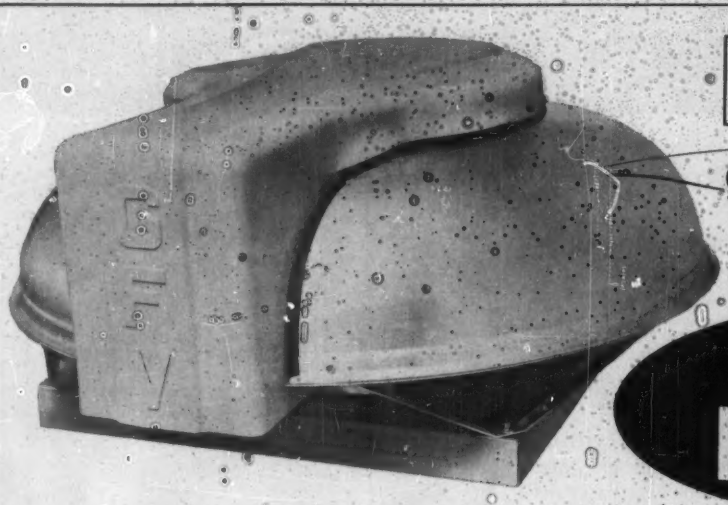

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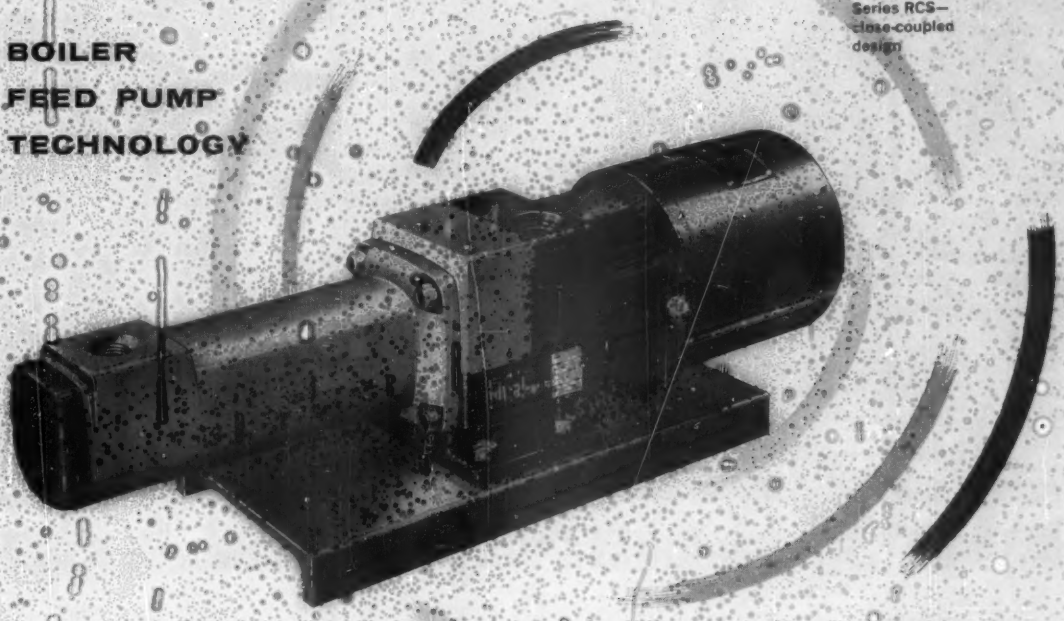

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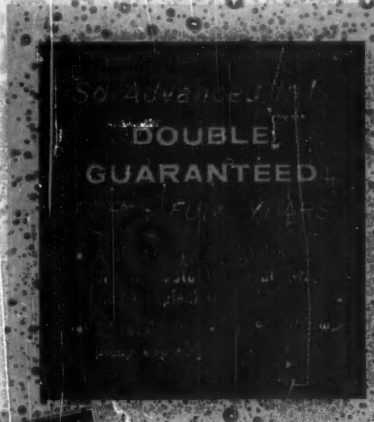

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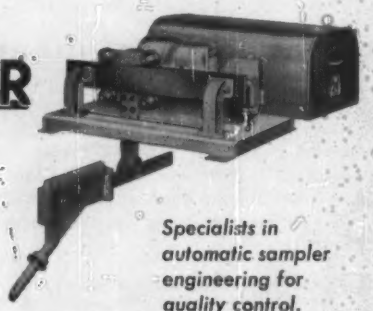

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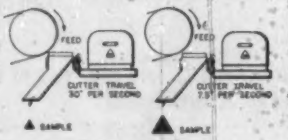


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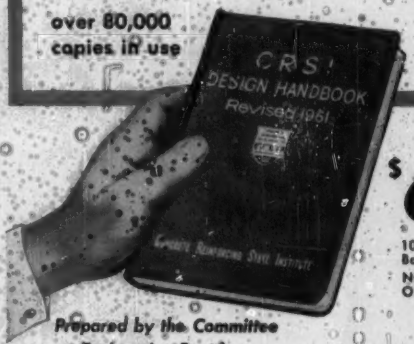


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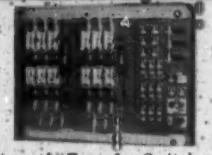

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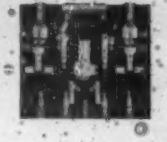

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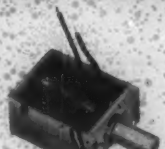

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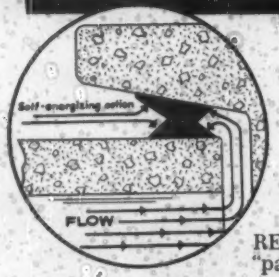


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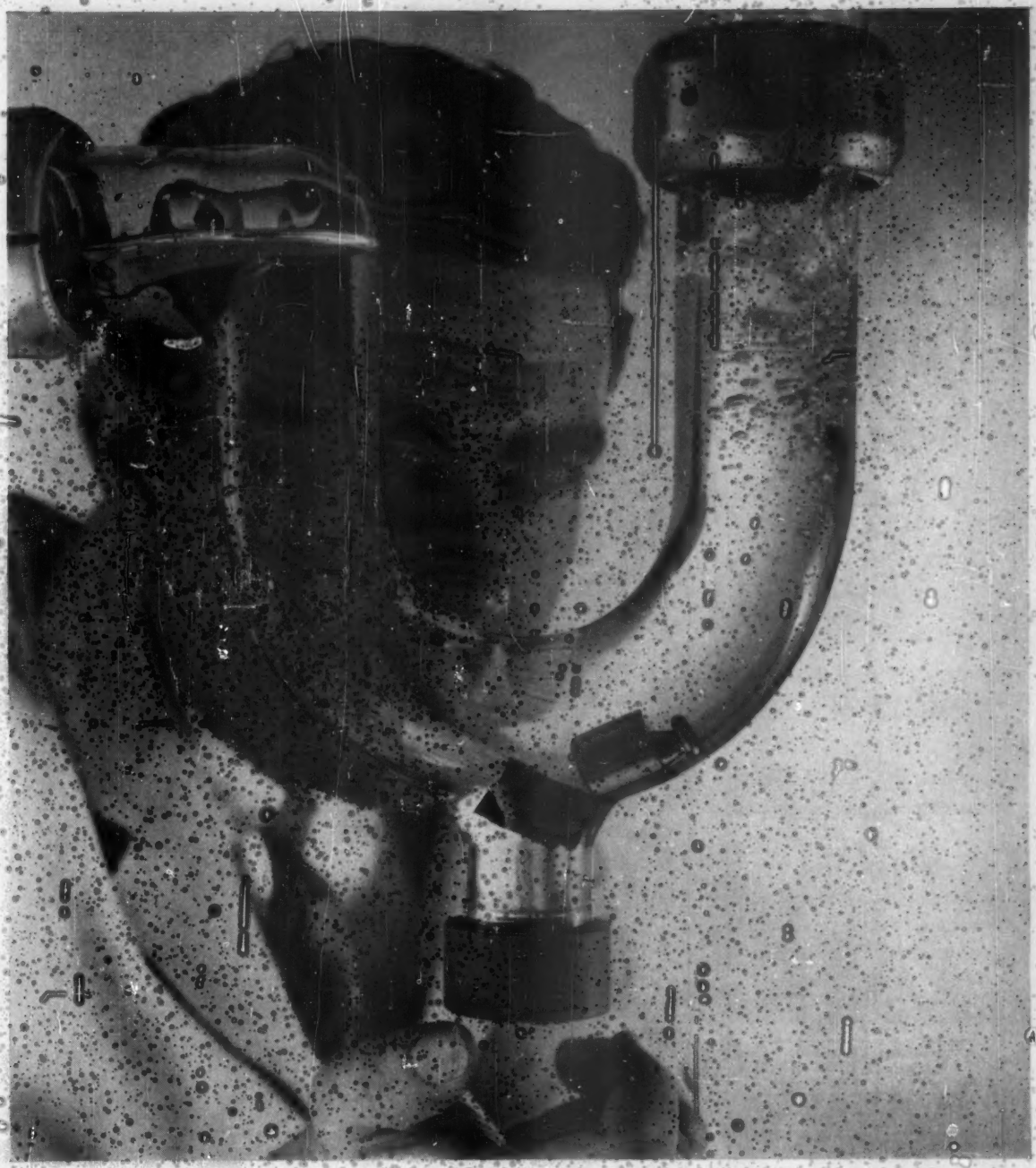

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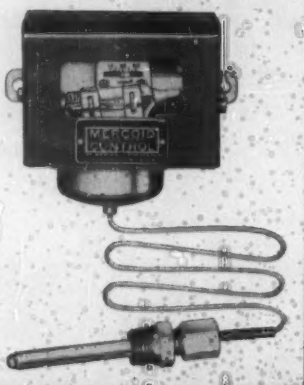

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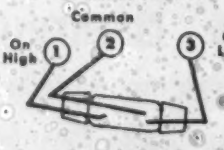
*SP Cut-in high*
*SP Double Throw*

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His solution: He installed Suburban Novent* and Dynavent* Gas Heaters.

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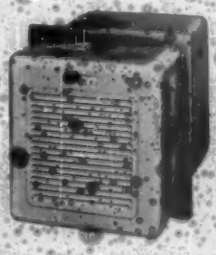

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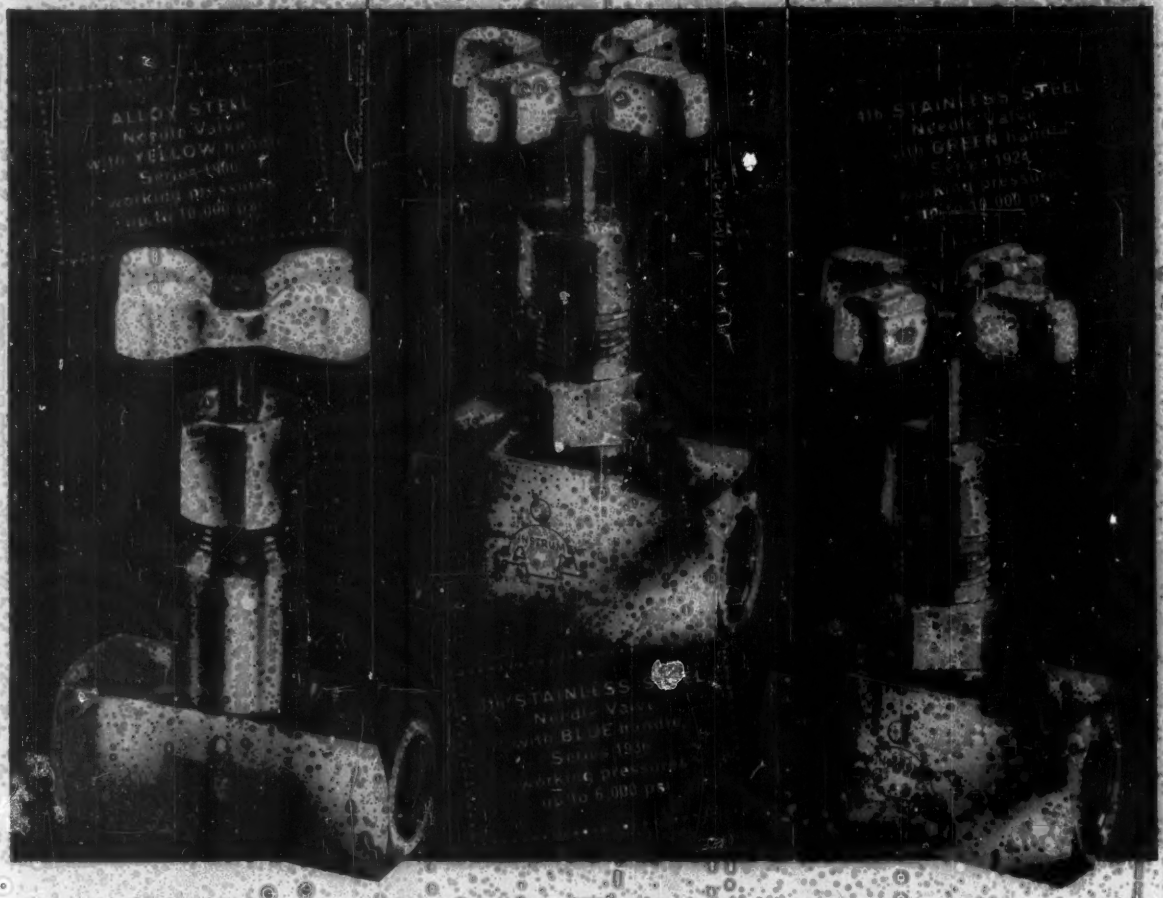


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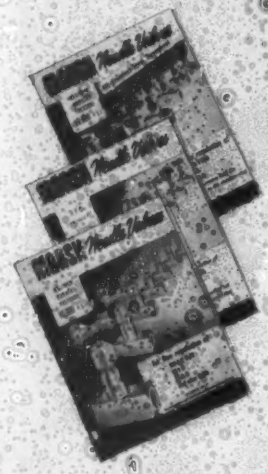

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The men who pull the switches will tell you what can happen when a switch, *believed* to be open —*isn't*. A lot of things can happen—and every one of them is bad. Personnel safety is in jeopardy. Motors can single-phase. Machinery and work can be damaged. Down-time can skyrocket.

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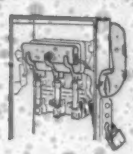
## Extra Safety with Square D's Handle Design



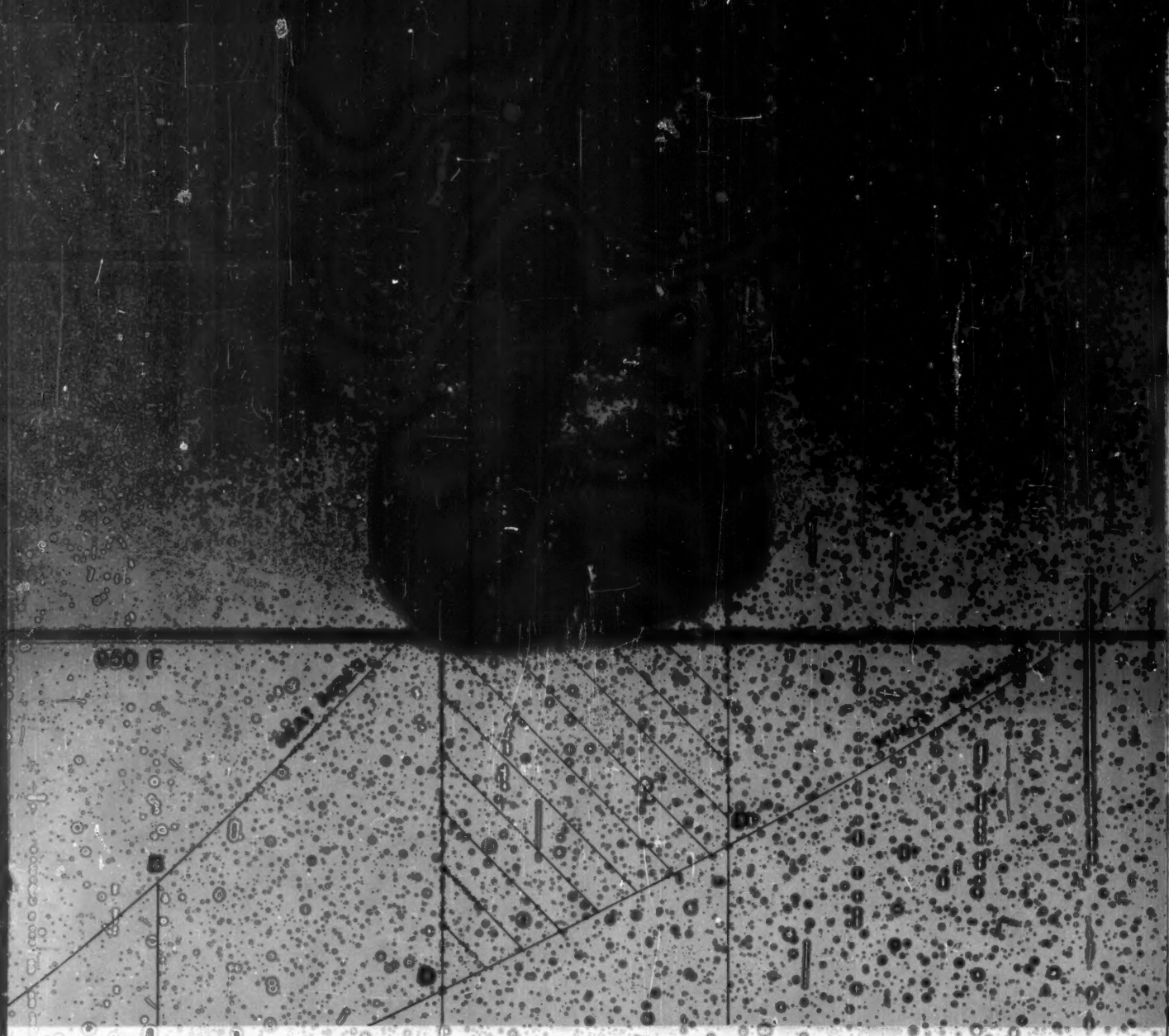
WHEN IT'S UP IT'S ON!

WHEN IT'S DOWN IT'S OFF!

Handle is integral part of switch, not cover. When door is opened, handle remains attached to switch. Eliminates hazard of false handle indication or defeat of padlock provision. When it's padlocked, it's locked!

**SQUARE D COMPANY**

*Wherever electricity is distributed and controlled*




# THE POWER RECOVERY "CHESTNUT"

## or how to take power from 950F—1250F tail gas

A proven method for taking mechanical power from process tail gas below 950F is the turbine. Taking power from tail gas above this temperature has, in the past, been a power recovery "chestnut"—too hot to handle despite its desirability. But now, Worthington offers a Power Recovery turbine that can successfully pluck the meat from this very hot "chestnut."

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In the past, use of Power Recovery turbines at the higher temperatures has been impractical. One major problem has been in mechanical design. Misalignment caused by excessive thermal expansion, higher temperature sealing, rotor construction, and forces imposed on the expander by inlet piping expansion and construction are all part of the problem. Today, Worthington has minimized them by creating a new design and using new materials.

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If you would like to taste the meat of this power recovery chestnut, above or below 950F, write or call Worthington Corporation, Turbine Division, Dept. 48-14, Wellsville, N.Y.

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